

LET'S MAKE GOOD STUFF:

**COMBATTING PLANNED OBSOLESCENCE AND JUNK BY
RELEARNING REPAIR, MAINTENANCE, AND PERSONAL
AGENCY OVER THE THINGS AROUND US.**

by

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AUTHORS DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

ABSTRACT

Let's Make Good Stuff explores our relationship with the designed objects around us. Mass produced items have an increased ability to provide everyone with good design, or to fill our world with sub-par products. This thesis sets out to define the difference between junk and good stuff, and to create an understanding of the importance of pursuing quality in the things we make.

Following in the footsteps of artists like Damien Ortega and Hans Hansen, as well as modern technology reviewers like iFixit, this thesis uses the tool of the teardown - the disassembly of something into its individual parts - to examine and become familiar with the histories and mechanics of mass production. Working with power tools as the area of focus, several questions begin to surface: What can be repaired, and what is worth repairing? How can we design better products that engage users in maintenance? And how can we engage in maintenance and repair work in products that weren't originally intended for it? In beginning to answer these questions, the thesis aims to show how designers and individuals can aim to make a more repairable and sustainable future.

Finally, with new agency over how things work and inspired by small-scale plastics recycling projects, there is a brief exploration of how designers can begin to close the materials loop in their own work and make a means of production for themselves, through the creation of an aluminum foundry.

Let's Make Good Stuff ultimately aims to show how people can begin to better their experience of the material world through engaging in practices of maintenance, modification, and repair, and the special importance for designers to learn through this type of hands-on exploration.

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LEARNING BY TAKING APART

Ever since the industrial revolution, society has shifted from relying on individual craft towards utilizing mass production¹. Continuing in this trend, many complex modern products aim to separate their function as much as possible from their internal workings, presenting themselves as perfect artifacts untouched by human hands. This style of design is present in the minimalist handheld vacuum cleaner that presents itself as a collection of simple geometries, as well as the glossy screen and smooth curves of a smartphone, hiding carefully orchestrated mechanisms and solid-state components that make them work. In combination with a reduction in technical education, which Matthew B. Crawford laments in his book *Shop Class as Soulcraft*², we have fallen out of touch with the things around us. Through practices of disassembly, whether for the purpose of repair or simply for interest's sake, we can begin to pull back the curtain of concealed and encapsulated design and re-educate ourselves.

The year of 2020 has been a year of turbulence, affecting daily life for nearly everyone and casting a spotlight on many of the failings of our designed social systems. The current climate of crisis has changed daily life for almost everyone, be it their occupations, routines, connection with their friends and family, or even their ability to be in the world outside of their residence. As we have all tried to adjust to our increasingly compartmentalized communal existence, we have had to learn to work and live with limited access to other people, things, and materials. It is no longer possible to simply walk into a store and try on clothing until we find the perfect pair of jeans; many companies have moved to fill this gap through online sales, making the worlds' wealthiest richer while small businesses scramble to catch up³.

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- 1 Batchelor, Bob. 2021. "The Development of Mass Production Has a Dramatic Impact on Industry and Society." *Encyclopedia.com*. February 1. Accessed February 12, 2021. <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/development-mass-production-has-dramatic-impact-industry-and-society>.
 - 2 Crawford, Matthew B. 2009. *Shop Class as Soulcraft: An inquiry into the value of work*. New York: Penguin.
 - 3 Ingraham, Christopher. 2021. "World's richest men added billions to their fortunes last year as others struggled." *Washington Post*. January 1. Accessed February 11, 2021. <https://www.washingtonpost.com/business/2021/01/01/bezos-musk-wealth-pandemic/>.



fig. 1.1
A selection
of tools and
equipment used
throughout this
thesis project.

The uptick in online sales is not the only trend to emerge; we can also see an emergence of people turning to old hobbies, video tutorials in crafts and baking, and an overall shift toward self-reliance. Some people are learning again how to make things for themselves⁴. And in making and creating our own artifacts we can then also look at how companies have manufactured the consumer items which we use. My thesis deals with tools that are products manufactured for various use. Through the teardown process I explore the design of these tools, and the information that can be learned when we open them up to reveal their inner workings. What are good products that can be usefully repaired? How can we change our interactions with product selection, usage, and maintenance?

Working within this new opportunity for self-reliance, we can begin to take back agency over the things around us. Since simply replacing broken things is no longer as simple an option as it used to be, we can learn to make use of the things around us and attempt to repair them for ourselves. And we are not alone in exploring how these things work; even though the detailed user manual seems to have gone extinct, we are more supported than ever with online guides posted in communities like iFixit and Instructables. There are already people out there who are learning to repair and build things for themselves, and most of them want to teach others what they have learned. Instructables is a community platform that was brought out from under its developer Squid Labs and into the public in 2006⁵. It is an online community for hobbyists and makers that share do-it-yourself tutorials for a wide variety of projects and repairs. The other online group, iFixit, describes itself as “site that teaches people how to fix almost anything. Anyone can create a repair manual for a device, and anyone can also edit the existing set of manuals to improve them.”⁶ Effectively making the attempt to crowdsource the user manual, iFixit is useful to people wanting to learn to maintain a particular device or perform a specific repair, while Instructables leans more toward the side of self-built projects. Although their focuses slightly differ, they share the community oriented, crowdsourced, and hands-on approach that maintenance needs to be fully successful.

Although this type of work is often, but not always, individual in nature, it is the shared resources like Instructables and iFixit that increase the individual success of the people who take part in it. Sharing knowledge, parts, and materials enable people to build upon others’ work, and not be

4 Barkho, Gabriela. 2020. “‘In a sweet spot right now’: Legacy crafting retailers and brands are seeing new signs of life.” *Modern Retail*. November 17. Accessed February 11, 2021. <https://www.modernretail.co/retailers/crafting-diy-hobbies-gain-momentum-as-the-pandemic-continues/>.

5 Instructables. 2006. *Our Story*. Accessed January 15, 2009. <https://www.instructables.com/about/>.

6 iFixit. 2003. *About Us*. Accessed November 18, 2019. <https://www.ifixit.com/Info/index>.



fig. 1.2
Tools used, tools
modified, and
tools made.

resigned to figuring everything out on their own. This benefits everyone who takes part in this type of work; People who repair and maintain out of financial necessity or lack of replacement availability, people who undertake restoration as a way of enjoying and caring for things from the past, people who modify and rebuild existing products to better suit their own needs, and people who want to integrate as much as they can learn from others in their own designs.

There are many things to be learned by taking things apart. We can discover how the individual item itself works, as well as the things that came together to make it⁷. In my own explorations of a series of drills, I have learned about manufacturing trends; increased sophistication of tools and subsequently more complex parts and assemblies, a shift away from expensive and stubborn metals to cost-effective and malleable plastics, and a tendency toward electronic controls over mechanical ones. Acting as mechanical archeologists, we can learn from these changes in the way things are made and assess their benefits and downfalls. A more complex part may be lighter but replacing it may be difficult if it breaks. Although making something out of plastic makes it cheaper, does it reduce the lifespan of the of the overall piece? And even though electronic controls can simplify production, does that also serve to mask the inner workings from somebody attempting a home repair down the road?

Disassembling tools can be an empowering mode of research and learning. The act of taking tools apart can teach us, not only about how tools are manufactured, but also about their weaknesses, planned and unplanned failings, showing how we can begin to design them to be better. In the first part of this project I detail what qualifies *good stuff*, discuss the problem of junk, and then look at what work is already being done to address the issues of mass market consumerism and the junk it creates. The actual tear downs and the rebuild are the focus of the later chapters along with the descriptions and videos of the work involved. In my conclusion I have suggestions for designers and for changes in the ways in which we engage with some the products we use in our daily lives.

As designers, we should carefully weigh the costs of modern trends and choose the best solutions from both old and new designs, creating items that are not only pleasing to use for their function, but are also easy to understand and repair, giving back an understanding of how things work to end users rather than creating enigmatic devices. By making a practice of disassembly and maintenance we can make better decisions in our own work, in turn making more opportunities for others to take personal agency over their own “stuff” and make a world that ultimately becomes more sustainable.

7 Lewis, Kemper et al. 2011. “Teaching the Global, Economic, Environmental, and Societal Foundations of Engineering Design through Product Archaeology.” *118th American Society for Engineering Education Annual Conference and Exposition*. Vancouver.



fig. 2.01

A hatchet, a pair of boots, an instant camera, and a gearshift; all modified or made to have greater personal appeal.



PROBLEMS AND SOLUTIONS

WHAT IS GOOD STUFF?

Imagine the fifty-year-old hatchet in the woodshed of your grandparents' home. That hatchet still works great! It only needs to be sharpened once a season and have its hickory handle oiled to protect it from moisture. Think of the cast iron pan in their kitchen that has a non-stick layer that can be refinished in a couple hours; whereas the Teflon pan in your student apartment collects more scratches, especially after your roommates decide to scrape it clean with a fork. Both the hatchet and the cast iron pan have qualities that make them enduring objects, their simplicity and material choice being some of the most important. However, simplicity is not implicit in all objects that are built to last; the 35 millimeter film camera that you still choose to carry because of the character and quality of the photos it produces and whose brass body has a heft to it that makes it feel invincible has also aged with grace, but it is a significantly complex assembly of specific parts.

The hatchet, the cast iron pan, and the camera all fall into a category that I would like to define as *good stuff*; things that perform their intended function well and are made so that they can continue to perform that way for a long time, essentially upholding utility, usability, durability, and maintainability. Something good should not only be functional, but it should also be a pleasure to use. It should be made well enough to avoid premature wear and breakage and it should be manufactured so that it can be maintained with instructions for that maintenance. I am choosing to use the terminology of *good stuff* for these items. I do this partly to reinforce the idea that there are things that are good and things that are bad, things that are productive to keep making and things that are problematic if we continue to produce them, and partly to play on the phrase "good stuff", often used as a way of commending someone on a job well done.



fig. 2.02

A Fiat Abarth spotted in Rome, Italy, a Ford Ranger spotted in Cambridge, Ontario, and a Ford Mercury Meteor spotted in Caledon, Ontario.



Good stuff is easy to identify when it is old, often simply because everything that was not well built from that time has been left behind, discarded because at some point it did not make the mark anymore. Time has a habit of sorting things out; although it supposedly heals all wounds it is not nearly as kind to material things which were not built to withstand the test of time. Items that are not maintained are soon forgotten, and things that do not perform their required tasks or break prematurely are simply discarded.

Using time as a method of sorting is one of the easiest and most reliable ways of ensuring that we are working with something that has been made well. If something has worked up until now, chances are that it will continue to work. If a few decades of wear and tear has left something functioning as it was meant to, it was likely designed to be either robust enough or maintainable enough that it will continue to perform those functions for quite some time.

Another aspect of *good stuff* is the design intent, which is what originally sets something out to be successful at its purpose and enjoyable during use. In the later chapters where I specifically focus on the mechanical elements of the tools, I will demonstrate that design is integral to the maintenance and the consequential durability consumer items, namely tools. The designs that incorporate a broad scope and knowledge of materials will be able to withstand usage through several decades.

The danger of allowing time to be too major a deciding factor in sorting out good from bad is that nostalgia can become overbearing. When we begin to think of everything that is old as good, we do not leave room for progress. Yes, that small-block Chevy is built like a tank and will probably run as long as you make sure it has oil in it, but it definitely is not doing the environment any favors, and if you get in an accident with it, the lack of modern seatbelts, airbags, and crumple zones certainly will not be doing you any favours.

Nostalgia may be one of the reasons that we choose to maintain things. Something that has personal memories attached to it is far more likely to get special treatment and care in comparison to a mass market item that was simply purchased for the sake of convenience. However, we do not want to let out feelings for things from the past get in the way of making things even better in the future. As technology, manufacturing, and science progress, there are ever more opportunities that simply were not possible, even for the best designs of past. It is important to acknowledge for example, that newer plastic products may have high quality as well, and in the future, time may also ascribe to these modern items the title of *good stuff*.



fig. 2.03
The ubiquitous disposable plastic fork.

The past can be very useful for teaching us about durability. Designs that have stood the test of time might be outdated in terms of material, manufacturing methods, or even the particular uses that they fulfill. But the thinking that went into making them can still be imparted onto the things that we make today. It does not mean that something is inherently good simply because it is old, but it is often more likely to be, and it almost always has something to teach us.

THE PROBLEM OF JUNK

If some things are good, what does the other end of the spectrum look like? I am almost certain most of us have had the experience of dealing with an inexpensive mechanical pencil that will not keep the lead in place, or a coin-operated dryer in a rental apartment that does not dry your clothes fully unless you run it for two or three cycles. You can probably think of other experiences with a dull knife, a piece of single use plastic cutlery breaking during use, or a bicycle pump that looks like it should work, but does not actually pressurize the tires.

Some of these examples may be due to a lack of maintenance. The landlord of your apartment is not motivated to get the dryer ducts cleaned, so the hot humid air in the dryer cannot escape quickly enough. Perhaps the landlord even prefers it this way, as the tenants essentially pay double to use the onsite laundry. The bike pump has probably been sitting in the garage through the hot and cold fluctuations of Canadian weather and has never had its internal seals lubricated or replaced, and so air simply escapes past them. The dull knife is probably in the kitchen of someone who has not yet been taught how to sharpen a knife properly. Here the issue is primarily one of education, of either learning how to properly care for the item to ensure that it remains functional or understanding why someone would choose to maintain the things around them in the first place.

In each of the above cases, the main issue is not one of design, although there is a strong argument that design is responsible for ensuring that a product will be maintained and allowed to function well over its lifespan. The question of good design is raised by the 2019 MoMA exhibit *The Value of Good Design*, asking “whether values from mid-century can be translated and redefined for a 21st-century audience.¹” Designs that champion durability, simplicity, and aesthetic that creates value make it possible for them to have longevity, be easily maintained, and to create an emotional connection with the user that causes them to want to take

1 Kinchin, Juliet, and Andrew Gardner. 2019. “The Value of Good Design.” *MoMA*. Accessed November 16, 2020.

good care of it. Where the commended designs of the mid-century create success and products that are still produced today because of peoples' continued interest and enjoyment of them, much of the design work that we see today leaves something to be desired. If things are not built to be durable we will not be enjoying them in seventy years, and if they are not built to engage us emotionally we likely will not even enjoy them in a few short months. When design does not strive to be good, when it ignores all the benefits that it can bring to the objects it eventually produces, it begins to follow methods that lead to the creation of junk.-

The first design approach that leads to junk is the production of goods for as little cost as possible, even at the consequence of reduced function. This scenario fits both the examples of the plastic fork and the mechanical pencil. The fork is made as cheaply as possible because it is meant to be used once and then thrown away. The evolution of this throw-away culture is described by Lester R. Brown in his chapter, "Designing a New Materials Economy" of *Eco-Economy: Building an Economy for the Earth*, where he states, "The throwaway economy evolved during the last half of the twentieth century. Throwaway products, facilitated by the appeal to convenience and the artificially low cost of energy, account for much of the garbage we produce each day and an even larger share of the material that ends up in landfills."² The larger issues of changing our disposable paradigm lead to the discussions of cultural changes where I suggest that the creation, maintenance, and repair of *good stuff* can be a major driver.

The mechanical pencil is not made to be disposable, but it effectively becomes that through its inevitable failure. The pencil is built to be as cheap as possible to make it more accessible to the consumer. The issue of cost engineering for profit potential may create an inferior product. There is an inability for the consumer to compare competing pencils because they are in plastic clamshell packaging, another challenge of modern commercial practices. Additionally, the buyer is usually not concerned enough to look up reviews for something that has relatively so small a cost. And when real and tangible qualities of products are difficult for people to engage with in stores, price becomes a more major deciding factor when choosing what to buy. In a study of consumer choice, Lisa Ordonez concludes that when price and quality are known then, "the next judgement the consumer makes is whether or not the product is a bargain or rip-off. In these cases price is the focal point and we appear to compare the actual price to an expected price."³ If consumers have been conditioned to expect low prices because of design trends that minimize cost, what room does that leave in the market for items that carry the additional cost of being built to endure?

2 Brown, Lester R. 2001. *Eco-Economy: Building an Economy for the Earth*. New York: W.W. Norton.

3 Ordóñez, Lisa D. 1998. "The Effect of Correlation between Price and Quality on Consumer Choice." *Organizational Behavior and Human Decision Processes* (Elsevier Inc) 75 (3): 258-273. Accessed January 6, 2021.

The less expensive option would be the better choice, if the merchants were really selling exactly the same product. In truth, the more expensive pencil probably becomes the better option at this point, because it will have parts sized well enough and made out of sufficiently durable materials to perform its function well, and to do it for a long time. The global markets and consumer interests may lead to choices which create the conditions for inferior products. For example, there was a time in the early nineteen-eighties when Japanese goods were flooding the markets, that Japanese products were perceived as having better quality than American made goods. In his book *Managing Quality*, David Garvin highlights that product quality was an important competitive issue. The conclusions were that, “Most startling, on both internal and external measures the poorest Japanese company typically had a failure rate less than half of the best US manufacturer.”⁴ This disconnect with American culture from product quality, even in everyday products that are not meant to be disposable, shows how the design ideas of disposable products have begun to push into the territory of non-disposable items. The designers of the cheaper pencil may have been forced to reduce material use and consider cheaper materials to meet their cost requirements. This leads to parts that will eventually wear out or break, leading to a pencil that no longer works and will be thrown out.

Putting the focus on making the product as cheaply as possible rather than as functional and moderately priced as possible, dooms it to becoming junk from the start. *Good stuff* demands higher design goals than this. The issues of the plastic fork breaking and the cheap mechanical pencil failing are not problems that result from the use of these items, but rather from the design approaches taken from the outset.

The second design approach leaves behind simply being problematic or misguided, and wanders toward more disturbing intentions. *Designed obsolescence* is the term used to describe the purposeful and designed limitation to the useful lifespan of a product. This no longer looks like the failing of a product due to inexpensive manufacturing.

In his book *Made to Break: Technology and Obsolescence in America*, Giles Slade gives a good depiction of the different forms of obsolescence. The first is *technological obsolescence*; the natural outpacing of things from the past by newer designs that incorporate advantageous developments in technology. This is innocent enough and is something that needs to happen if we are to continue to progress. However, if the speed of technological progress becomes quicker than past products are needing to be replaced, it can lead to the premature replacement of things that still perform their designed function. The second type of obsolescence is *perceived obsolescence*, and this is where we really need to question

4 Garvin, David A. 1983. “Quality on the Line.” *Harvard Business Review*. September. Accessed January 5, 2021. <https://hbr.org/1983/09/quality-on-the-line>.



fig. 2.04
Technological Obsolescence Collage



fig. 2.05
Planned Obsolescence



fig. 2.04
Perceived Obsolescence Collage

the motives of designers and manufacturers. *Perceived obsolescence* is the creation of visible differences in new products, even if the product is essentially the same as the previous offering. This is most relatable to yearly redesigns of cell phones, car model years that give the vehicle a facelift but do not include a more efficient engine or increased safety features. *Perceived obsolescence* is the purposeful use of the manufacturer of design to change the visual appeal of something, to make its previous offerings look outdated and encourage consumers to replace them even when they are still working. Finally, the third and most nefarious type of *designed obsolescence* is called *planned obsolescence*⁵.

Here we see the expensive vacuum cleaner built with a cheap switch that will burn out after two years. Or the flagship cellphone that will stop receiving software updates after three years. And possibly worse, having its speed crippled remotely by the manufacturer⁶. Another example is the expensive and well-built blender that you bought that was fifty dollars cheaper than its competition. However, the plastic housing is sealed up with adhesive rather than screws and does not allow you to replace the wearing parts of the motor. The design thinking that goes into *planned obsolescence* is arguably worse than the misguided approach of lowest cost creation; it takes products that would otherwise perform for a very long time and artificially shortens their lifespans, through design decisions.

Why would a manufacturer ever choose to do something like this to one of their products? The simple reason is that it creates buying cycles: the consumer is forced to purchase the product over-and-over again⁷. By making ninety-nine percent of the product well, it ensures that the overall experience and use of it is positive for the consumer, only ruined by the one component that is designed to fail. This makes it relatively likely that the consumer will purchase from the same manufacturer again, possibly even opting for the upgraded model in the hopes that it will last longer. They may then buy what is really the same product in a slightly redesigned plastic housing with a highlight colour to set it apart. And so, manufacturers that design with planned obsolescence thinking accept the reality that they make things that will fail by weighing it against greater and more continuous capital gain.

Both of these approaches result in the creation of junk. The first attitude is easier to dismiss because the products themselves could readily be seen as junk to begin with. The second approach is more problematic because

5 Slade, Giles. 2006. *Made to Break: Technology and Obsolescence in America*. Cambridge: Harvard University Press.

6 Gibbs, Samuel. 2018. "Apple and Samsung fined for deliberately slowing down phones." *The Guardian*. October 24. Accessed February 10, 2021. <https://www.theguardian.com/technology/2018/oct/24/apple-samsung-fined-for-slowing-down-phones>.

7 Wikipedia. 2021. *Planned Obsolescence*. February 10. Accessed February 11, 2021. https://en.wikipedia.org/wiki/Planned_obsolescence.

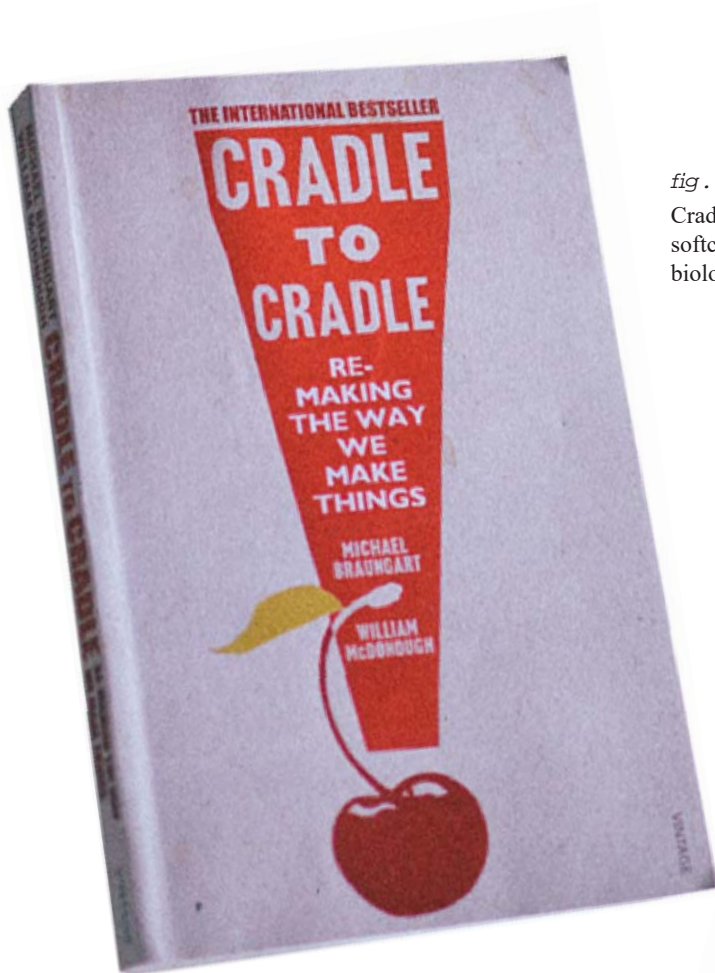


fig. 2.06

Cradle to Cradle published in a familiar softcover paper format, utilizing biological nutrients.

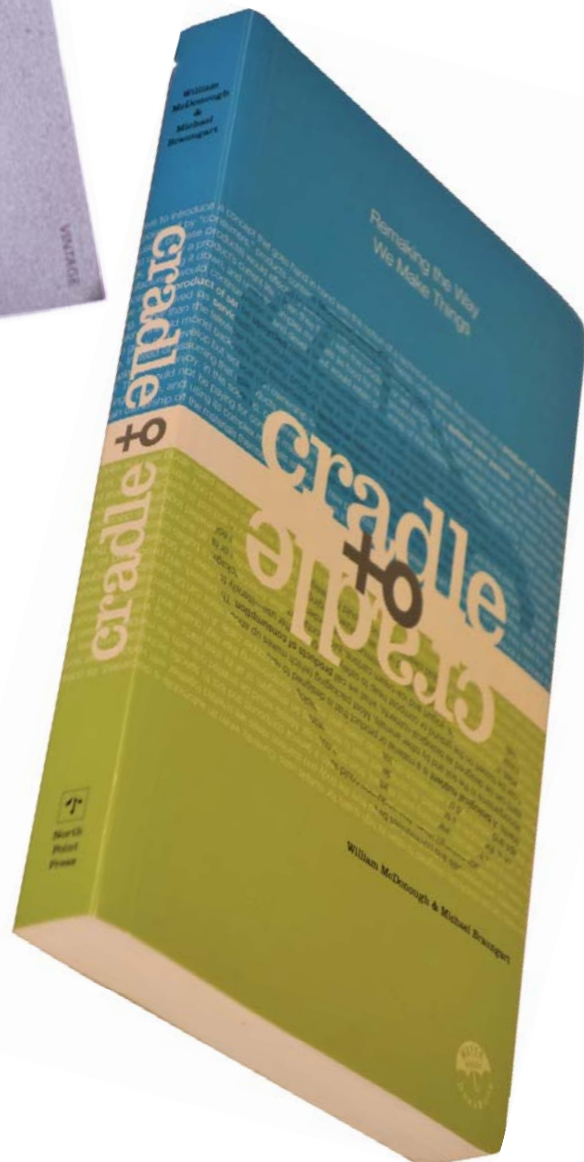


fig. 2.07

Cradle to Cradle published in a new plastic format, utilizing technological nutrients.

it creates waste out of something that otherwise would have had a lot more use. Although they stem from different mindsets and lead to slightly different ends, they both feed into the same problem: the overproduction of goods and the subsequent disposal of their materials as waste at the end of their useful lives. This overproduction and the wastes generated by it are fueling an ecological crisis that our planet cannot sustain. In the next chapters I propose and demonstrate alternate and specific interactions with our material goods, if we are willing to learn how to have agency over them.

THE MOVEMENT TO REPAIR

The problems of junk and obsolescence are complicated challenges to be taken on. Luckily, there are plenty of people already at work on them. *Cradle to Cradle: Remaking the Way We Make Things* was published by Michael Braungart and William McDonough in 2002, which looks at these issues from an environmental and human-wellness perspective. Separating material into “Biological Nutrients”, natural matter that can decompose and become part of natural cycles, and “Technological Nutrients”, metals and mineral based materials that are (for the most part) outside of the natural metabolism, Braungart and McDonough argue that these materials should be kept apart and in their respective cycles. They propose doing this through creation of closed-loop manufacturing, processes that indefinitely cycle material within its given Biological or Technological home, thinking of products as a temporary arrangement of their materials rather than a finite object with a lifespan⁸.

Building on this thinking, Circular Economy systems have been further expressed by groups like the Ellen MacArthur Foundation⁹. In particular, their circular economy system diagram depicting the spheres of “Renewables” and “Finite Materials”, synonymous with “Biological” and “Technological” nutrients in *Cradle to Cradle*, gives a useful depiction of the specific levels of processing and work that our material goods undergo. The depiction of the Renewables loop is relatively simple; a mostly straight line that goes through the cycles dictated by natural processes. Within that loop, the best thing that we can do is to keep our own mess out, ensuring that natural processes can continue without interference from

8 McDonough, William, and Michael Braungart. 2009. *Cradle to Cradle: Remaking the way we make things*. London: Vintage.

9 The Ellen MacArthur Foundation. 2017. *Mission and Vision*. Accessed November 16, 2020. <https://www.ellenmacarthurfoundation.org/our-story/mission>.

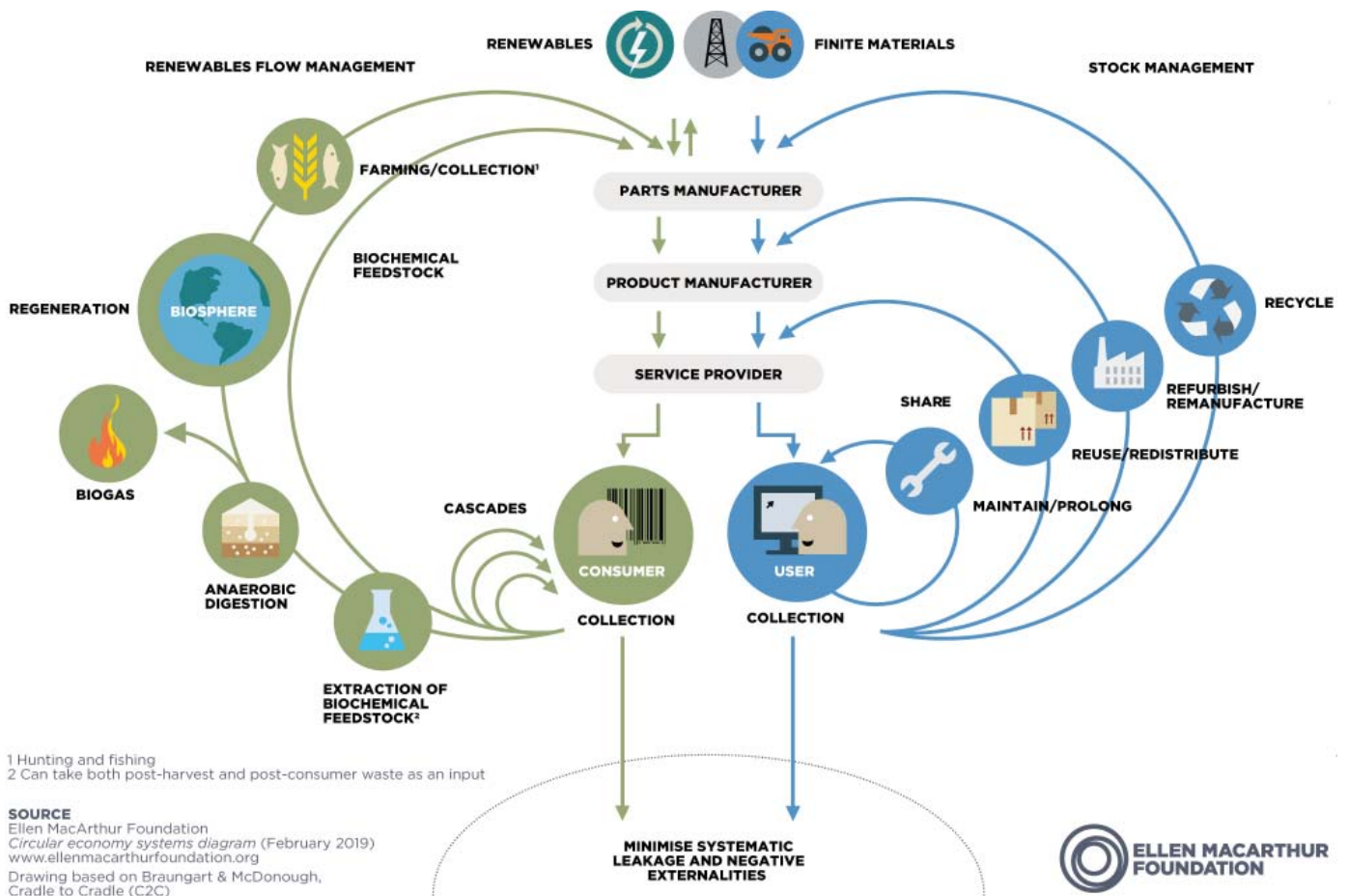


fig. 2.08

A Circular Economy diagram by the Ellen MacArthur Foundation, highlighting the spheres of biological and technological stocks, or nutrients, as described in *Cradle to Cradle*.

source: <https://www.ellenmacarthurfoundation.org/circular-economy/concept/infographic>

other materials we use. The Finite Materials loop on the other hand has more branches, depicted as several loops, giving us areas of intervention. The importance of this diagram is that it creates an order for these different loops, giving them cascading level of importance or impact. Within the diagram, the argument is that the smaller the loop the more effective it is at reducing impact, as the smaller the loop is the less steps it has to go through.

Notably within this diagram, the “green” option that we tend to go to the most often, Recycling, is actually the outermost loop. This is because it actually requires the most work and input of new energy and resources out of all of the options. Rather than immediately jumping to it, this diagram argues that we should first go to other methods of managing Technical Nutrients. As the loops get smaller, another benefit is that they become easier to interact with at the scale of the individual. The smallest loop, encompassing Sharing, Maintaining, and Prolonging, is easy to see as things that are taken on by individuals. Reusing, from the next loop outward, is also easy to see in this context. When branching into the wider areas things get harder to see at a small scale, Redistribution, Refurbishing, Remanufacturing, and Recycling all being ways of interacting with these materials that require either specific knowledge, networks, or equipment. The good news is that, as the argument goes, as individuals we can actually have the biggest impact by choosing to engage in these smaller, more accessible loops¹⁰.

There are groups trying to make it easier for consumers to work at these lower levels. Notably, Right to Repair legislation is being lobbied around the world as people push for their rights to fix the things that they own. The European Union passed new standards that as of 2021 will apply to many larger electric appliances like kitchen and laundry equipment.¹¹ The laws presented essentially make requirements for manufacturers to provide the required documentation to repair their products to repair businesses, as well as the necessary parts to make those repairs possible. This will not only allow lifespans of products and equipment to be prolonged through repair, it will make repair open to product owners and repair shops that are not owned by the manufacturer. Hopefully as this type of legal framework for repair continues to develop it will also include individual users rather than only repair technicians.¹² It is very strange that repairable products

10 The Ellen MacArthur Foundation. 2019. *The Circular Economy in Detail*. Accessed December 22, 2019. <https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail>.

11 Hahn, Jennifer. 2019. “EU recognises “right to repair” in push to make appliances last longer.” *Dezeen*. October 1. Accessed October 14, 2019. https://www.dezeen.com/2019/10/01/eu-right-to-repair-design/?fbclid=IwAR0MtiBhhVEZG4LgSxduYfvMUZmJWHdUNOAqUX62OXZaVRYk-fqi_eVa-Sw.

12 Harrabin, Roger. 2019. “EU Brings in ‘right to repair’ rules for appliances.” *BBC*. September 30. Accessed January 14, 2021. <https://www.bbc.com/news/business-49884827>.

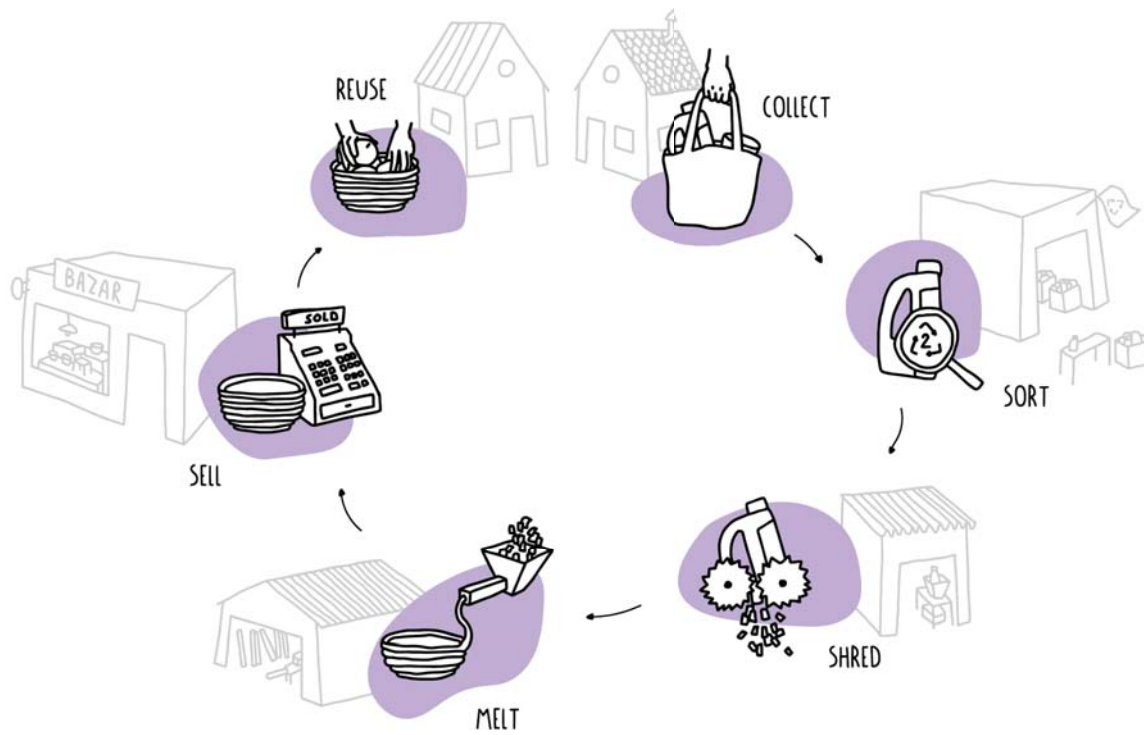


fig. 2.09

The Technical Nutrient cycle that the Precious Plastic Project is designed to work in.

source: <https://collect.preciousplastic.com/>

fig. 2.10

Version Three of the Precious Plastic Machines

source: <https://preciousplastic.com/solutions/machines/basic.html>



are no longer the norm, and creating a legal framework to ensure that manufacturers are making things that are worth repairing, and possible to repair, is an important step to getting back to this.

Work has also been done to try to shrink the largest loop of Recycling. The Precious Plastic Project, by Dave Hakkens and a large community of collaborators, is designed as a small-scale plastics recycling toolset. It includes equipment for processing plastic products to turn them into reusable materials, and other equipment for turning that new material back into products through a variety of different processes¹³. The project has expanded to slightly more industrial equipment, providing greater workflow for groups that are processing more plastic, but it still includes small machines for individuals and community workshops who want to expand their abilities without breaking the bank. Solutions like this are exciting, especially to designers, because they enable the means of production and the means of collecting material to be brought under one's own direction in an accessible way. This not only creates opportunities for solving plastic waste issues in communities that do not have access to larger scale recycling; it also creates greater opportunity for diversified design by removing barriers caused by larger scale equipment.

Projects like this, and the type of thinking that goes into them, will be an important part of solving the issues of junk and obsolescence. But even though it is made to be as accessible as possible, the Precious Plastic Project is still a bit overwhelming for most people to imagine taking on themselves. However, the reminder of the diagram from the Ellen MacArthur Foundation is that we are still more effective when we engage with the things around us in the practices of maintenance and repair. So not everyone needs to start a plastic recycling workshop in their garage, but it might be useful for some people, especially designers.

My thesis primarily uses the “teardown” as the crucial method of investigation. This is one of the fundamental parts of the smallest loop, being a part of quite a bit of maintenance work and almost all repair work. The teardown is like an archeological dig, but instead of bones and rocks below the layers of earth, we reveal the gears and springs below the smooth exteriors of artifacts or tools. Like an archeological dig, when we take apart something from the past, we learn about what thinking, material, and manufacturing techniques went into making that object. Particularly, when we “dig” deeper and compare older objects to those that are newer, we are able to see how design trends have shifted, how material options have expanded, and how progressions in technology have allowed different manufacturing methods and forms to be explored. Karl Ulrich and Scott Pearson use this kind of *Product Archaeology* to examine existing goods on the market and to try to estimate manufacturing cost in comparison to

¹³ Hakkens, Dave, and al. 2013. *The Precious Plastic Project*. Accessed August 8, 2018. <https://preciousplastic.com/>.



fig. 2.11

A disassembled Volkswagen Golf photographed by Hans Hansen

source: https://www.fotomuseum.ch/en/explore/collection/152440_zerlegter_vw_golf



fig. 2.12

Cosmic Thing by sculptor Damian Ortega

source: <https://www.influx.co.uk/blog/damian-ortegas-cosmic-thing/>

price, in an effort to establish how design decisions effect the profitability of a product¹⁴. This reverse engineering of costs through the teardown has also been used as a way of teaching engineering students the impacts of their use of fasteners and materials¹⁵.

The teardown has also been used to explore more artistic interests. Hans Hansen created a series of images for Volkswagen showing disassembled and “knolled” versions of some of their vehicles, most notably the 1988 Golf¹⁶. Knolling is a type of visual organizing that keeps like parts together, and often keeps them in the same general locations as they were originally located in the assembled piece. Usually organized on a Cartesian grid, this way of organizing is naturally appealing and easy to understand to the human eye as everything is laid out logically. Similar to Hansen’s work, Damien Ortega disassembled a classic Volkswagen Beetle for his sculpture *Cosmic Thing*. However, rather than laying out the disassembled pieces flat, he chose to explode it in three-dimensional space, suspending it from thin cables in the orientation and the order that they were in the assembled car¹⁷. Toronto photographer, Todd McLellan, also follows this methodology of taking things apart in his book *Things Come Apart*, where he explores and celebrates the parts that make up everyday objects of various scales, from a mechanical pencil to a small airplane. McLellan, however, chooses to mix the visual tool of knolling with more animated composite images of the components in midair¹⁸. This contrast provides both an animated perspective as to what those individual components look like, as well as displaying the organized appeal of knolling. Finally, in a rather humorous exploration of a cheap toaster, Thomas Thwaites uses the teardown as the launching point. Thankfully for the readers the adventure doesn’t end there, but continues with a challenge to recreate a common appliance entirely from scratch¹⁹.

Returning to a more utilitarian use of disassembly, teardowns by groups like iFixit²⁰, help consumers make better decisions about purchasing items. An example of this are the smartphones that are laid bare before the camera,

14 Ulrici, Karl T, and Scott Pearson. 1998. “Assessing the Importance of Design Through Product Archaeology.” *Management Science* 352-369.

15 Lewis, Kemper, Deborah Moore-Russo, Omar M Ashour, Timothy W Simpson, Gul Kremer, Xaver Neumeier, Ann F McKenna, and Wei Chen. 2011. “Teaching the Global, Economic, Environmental, and Societal Foundations of Engineering Design through Product Archaeology.” *118th American Society for Engineering Education Annual Conference and Exposition*. Vancouver.

16 Hansen, Hans. 1988. “Photograph of a Disassembled Golf CL.” Fotomuseum. *Im Auftrag der Volkswagen AG, Art Director Dietmar Meyer*. Germany.

17 Ortega, Damian. 2002. *Cosmic Thing*.

18 McLellan, Todd. 2013. *Things Come Apart*. London: Thames & Hudson.

19 Thwaites, Thomas. 2011. *Toaster Project*. New York: Princeton Architectural Press.

20 iFixit. 2003. *About Us*. Accessed November 18, 2019. <https://www.ifixit.com/Info/index>.



fig. 2.13
 A disassembled chainsaw photographed by Todd McLellan
 source: <https://www.toddmclellan.com/disassembledchainsaw>



fig. 2.14
 The cheap case-study toaster used in Thomas Thwaites' *Toaster Project*

examining how well built they are as well as rating how repairable they are. These teardown reviews contrast the typical surface level glimpses that usual reviewers leave. The iFixit global community looks at the actual parts and how something is built in comparison with simply reading off spec sheets and giving an opinion on how something looks, feels and performs. Both of these are useful, but a teardown helps to give a more rounded, qualitative picture rather than the qualitative perspectives that we are used to seeing. As these teardown reviews become more popular as a means of understanding, combatting, and avoiding cheapness and cut corners on the part of manufacturers, chances are that with a quick search online you can find this sort of information for any assembled item you may be considering purchasing.

As a designer, the methodology of the teardown actually poses a more specific experience than a utilitarian way of rating something or an artistic expression of complexity. Similar to a real-life version of an exploded axonometric, taking something apart gives us a real, hands-on experience with each component of a thing. This is something that cannot be recreated through digital rendering or even fully through model making. The teardown engages us in new ways to look at and to consider how artifacts and tools are expressions of our culture and how we interact with consumer goods.

THE DRILLS

A BRIEF HISTORY

The benefit to the designer of the teardown is to expand on our own personal experience of assemblies, mechanisms, manufacturing types, material, and assembly strategies in order to incorporate the best efforts of the designs of the past into future work. This is how we learn from the artifacts of the past. I would argue that hands-on approaches are best, and one of the main methodologies that this thesis will use is that of the teardown: the act of taking something apart, reducing it into its individual components.

Although I personally find that the hands-on approach is the most productive and yields the most significant takeaways for these products, there is still a lot that can be learned through historical research. For example, finding photographic examples of what a tool manufactured by the same company has looked like, and how it has changed, over the last half century. Looking at how one company's manufacturing, form, and power strategies have changed, even at the surface level that we get with photographs, can teach us about the product design of each time period and how it developed from the last. Things like user manuals and advertisements from the past can help us to understand the societal aspects of what made these tools the way that they were, how people were expected to interact with their products, and looking into old patent drawings can help us to understand progressions in technology without even having to get our hands dirty.

With the benefit of already knowing the drills that I take apart later on in this chapter, I set about looking into the lineage of the Black and Decker Manufacturing Company's drills. The company was started by S. Duncan Black and Alonzo G. Decker in 1910¹. Although Black and Decker did not

1 Sommerville, Sean. 1997. "He's still a company man Founder's son: Alonzo G. Decker Jr., son of one of the founders of Black & Decker, helped spark the do-it-yourself movement. As he approaches his 89th birthday, he maintains his connection to the family business." *The Baltimore Sun*. January 5. Accessed January 13, 2021. <https://www.baltimoresun.com/news/bs-xpm-1997-01-05-1997005004-story.html>.



fig. 3.2

A selection of Black & Decker drills, showcasing the increasing use of plastics, the changes in form, and the introduction of new technologies like variable speed triggers and batteries.

actually invent the drill (it was first invented by Arthur James Arnot and William Blanch Brain, and the first portable unit was made by Wilhelm and Carl Fein of the Fein Mechanical Workshop²), they did give it the hand grip and switch that is so ubiquitous with the form of the hand drill, even today. This “pistol grip and trigger switch” plays a major role in some of their early advertising, arguing for greater worker efficiency and productivity. And with this basic layout of the handheld drill essentially taking over the entire market, it seems they were right.

This early advertising, and their early drills, were aimed at an industrial setting. Where things really get interesting, at least in my opinion, is when the shift occurred to bring these power tools into the home, or at least the home workshop. The Black and Decker Home Utility drill left behind the rigid, hexagonal body of the industrial drills and adapted a curvilinear, softened geometry. While the sharp corners and mechanical looking industrial drills would have had a design language that was familiar to people working in machine shop environments and assembly lines, the softened design language for the home use tools is more reminiscent of sewing machines and stand mixers, effectively power tools that were already found in the home. The drills were also made available in smaller sizes, with quarter inch and half inch drive shafts in addition to the three-quarter inch size, becoming well suited for small workbench jobs rather than factory work.

Looking at the progression of the drills from Black and Decker over the years, what becomes most prominently displayed is the switch from cast aluminum casings to injection molded plastic shells. The plastic starts in the hand grip, presumably first integrated there to introduce extra electrical insulation. The gearbox and motor are still housed in sturdy aluminum. However, advancements in plastics and plastics manufacturing technology seem to have led the design team to later lean on them for the whole body of the drill, as plastics today are cheaper and easier to produce than metal parts.

But this thesis is about the necessity of hands-on approaches, so I will get back to that. After a brief take-apart of a space heater from the local thrift store as a test for the usefulness of teardowns for this thesis, I focused back on a set of three drills. The first, and newest, is an IKEA Fixa drill purchased new from their online store and delivered to my door for approximately thirty-five Canadian dollars (it was on sale at the time, the current listed price is fifty Canadian). It is compact, cordless, and comes with a small set

2 Wikipedia. 2021. *Electric Drill*. January 5. Accessed January 15, 2021. https://en.wikipedia.org/wiki/Electric_drill.



fig. 3.3
 Early disassembly work from M1 Term,
 September to December 2019. A small
 space heater and a set of drills.

of bits for working with screws and a couple of twist drill bits as well as a charger. The drill is marketed toward people wanting to hang pictures, put together IKEA's furniture, and perform small repairs around the house.

The second drill is a broken Dewalt given to me by the Waterloo Architecture's Fabrication Lab manager, Heinz Koller. The Dewalt was made in the 2000's and is also battery operated. However, it uses Nickle-Cadmium batteries rather than the newer Lithium-Ion cells, common in tools today, and which are used in the Fixa drill. The Dewalt is much more robust and designed for full time use, oriented toward people using it in the workshop or on jobsites.

The third and final drill is a Black and Decker Home and Utility drill, and it is the oldest by far, being manufactured in the fifties. My grandfather purchased it for me for five dollars from the Cambridge Fifty-Plus Woodworkers Guild sale. It is corded, as batteries were not quite ready to be operating power tools back then, and it has a cast aluminum housing. Both Dewalt's and IKEA's offerings are only available in injection molded plastic.

THE TEARDOWNS

I disassembled them in order of oldest to newest. The beauty of the cast aluminum shell of the Black and Decker was that it was all held together with standard or flathead screws, and everything could be taken apart with only one screwdriver (except for two small grub screws that held in the brush holders). The housing is also extremely robust, which is part of why the drill was still in relatively good shape after seventy years. Almost all of the screws and individual components in this drill are large and easy to handle and keep track of, which also helped keep the disassembly simple. The number of parts was also relatively small, most notably in the gearbox which held a set of only three gears. A unique and exciting feature of the Black and Decker is the inclusion in the molding of the casing for the user to add another handle. This feature is useful for drilling under heavy loads, providing an extra grip when needed. However the approach also shows wisdom on the part of the designer: rather than include the part with the drill, which would increase the cost of the drill, they designed the socket to fit a one inch national pipe thread fitting. With this piping being commonly available, and almost certain to be on any jobsite in North America, this ensured that the extra handle could be easily added when necessary but did

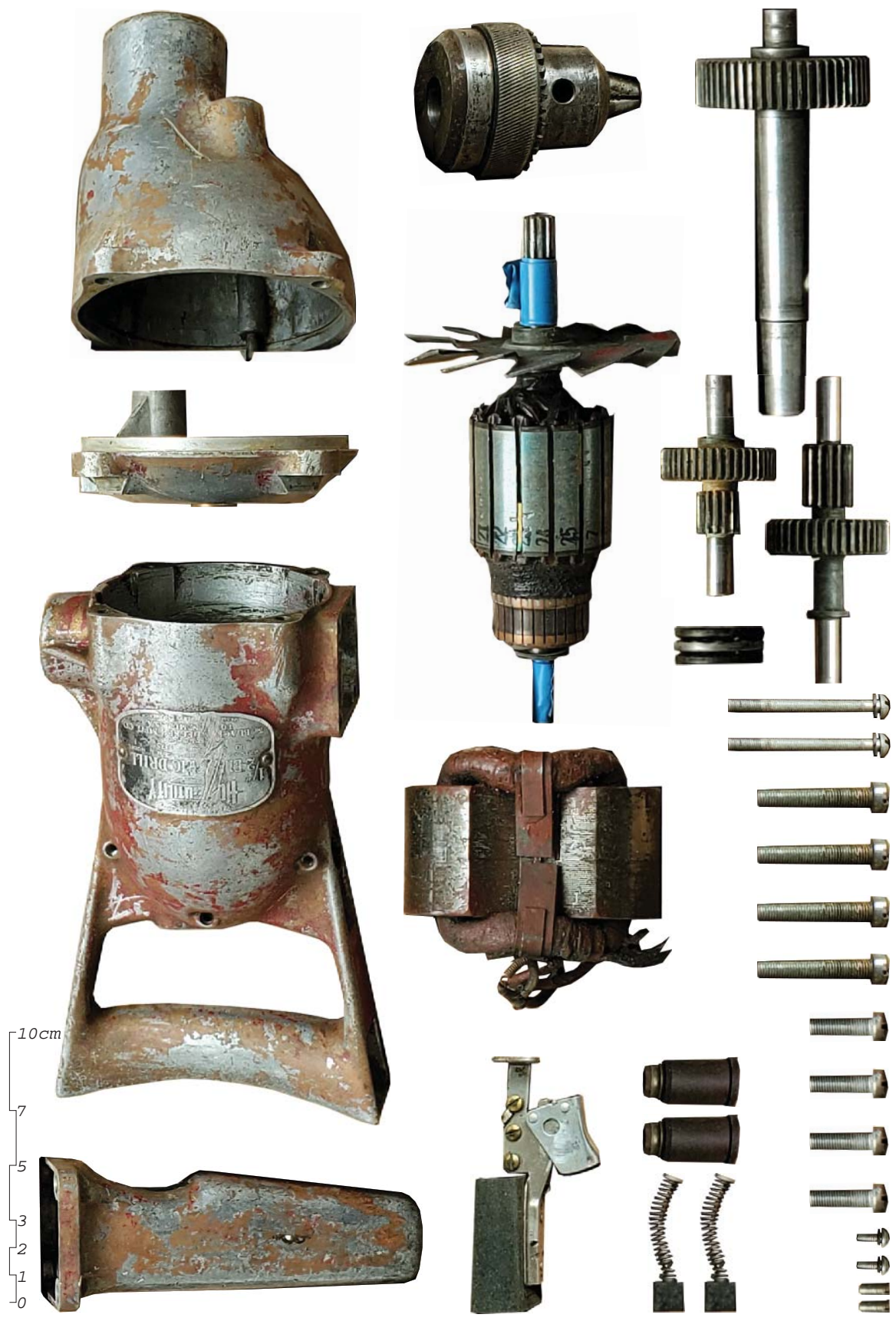


fig. 3.4 Collage of the parts from the Black & Decker Home Utility drill. Stills from the video are in the appendix.

not make is so precious that the user needed to constantly keep it with their drill. Using a standard thread also means that the drill could potentially be used in a homemade drill press or similar tools, using the tread as a mount to get additional utility out of the drill.

When I cracked open the yellow Dewalt drill, I quickly found that there were quite a few more parts - many more, in fact. The gearbox, being the main culprit, was home to a set of planetary gears rather than simple spur gears, which gives the drill the added function of having two gear ratios rather than one. The manufacturers also managed to fit a rotary hammer mechanism in this drill, though not one as substantial as a drill designed for heavy construction and demolition. It essentially just uses cams to mimic a hammering action.

The way that the housing of the Dewalt drill came apart was simpler than the Black and Decker drill and provided easier access to everything. It was injection molded in plastic rather than cast in aluminum. Although it is not quite as durable, plastic is lighter and also has the added benefit of being an insulator, which helps with ensuring electrical safety while using the drill. The Black and Decker simply grounds the aluminum housing to ensure that any short circuits do not travel into the operator through the casing, but the Dewalt does not even have to worry about this being an issue.

There are many small Phillips screws that are used to keep the shells together in the Dewalt drill. They are given a coarser thread to allow them to tap their own holes during assembly, saving precious minutes of machining time or using extremely complicated plastic molding. Some other significant additions of the Dewalt compared with the older drill are: the removable battery pack allowing remote operation but limiting power in comparison; the variable trigger allowing finer control which is important especially when driving screws; and finally, a keyless chuck for holding bits that can be tightened by hand easily, rather than the older Jacob's chuck that requires a tool to be effectively tightened. Most importantly, a clutch is included, which keeps screws from being over-tightened or stripped out when being fastened with the drill.

Finally, the IKEA Fixa was on the table. It was much smaller, and substantially lighter than either of the other drills. Like the Dewalt, it has a battery; however, it is internal and charged by a barrel jack connector similar to what is used in many other electronics with internal batteries. This is beneficial in that the charging circuit is inside the drill. But, once you run out of battery power you need to stop and recharge, whereas with

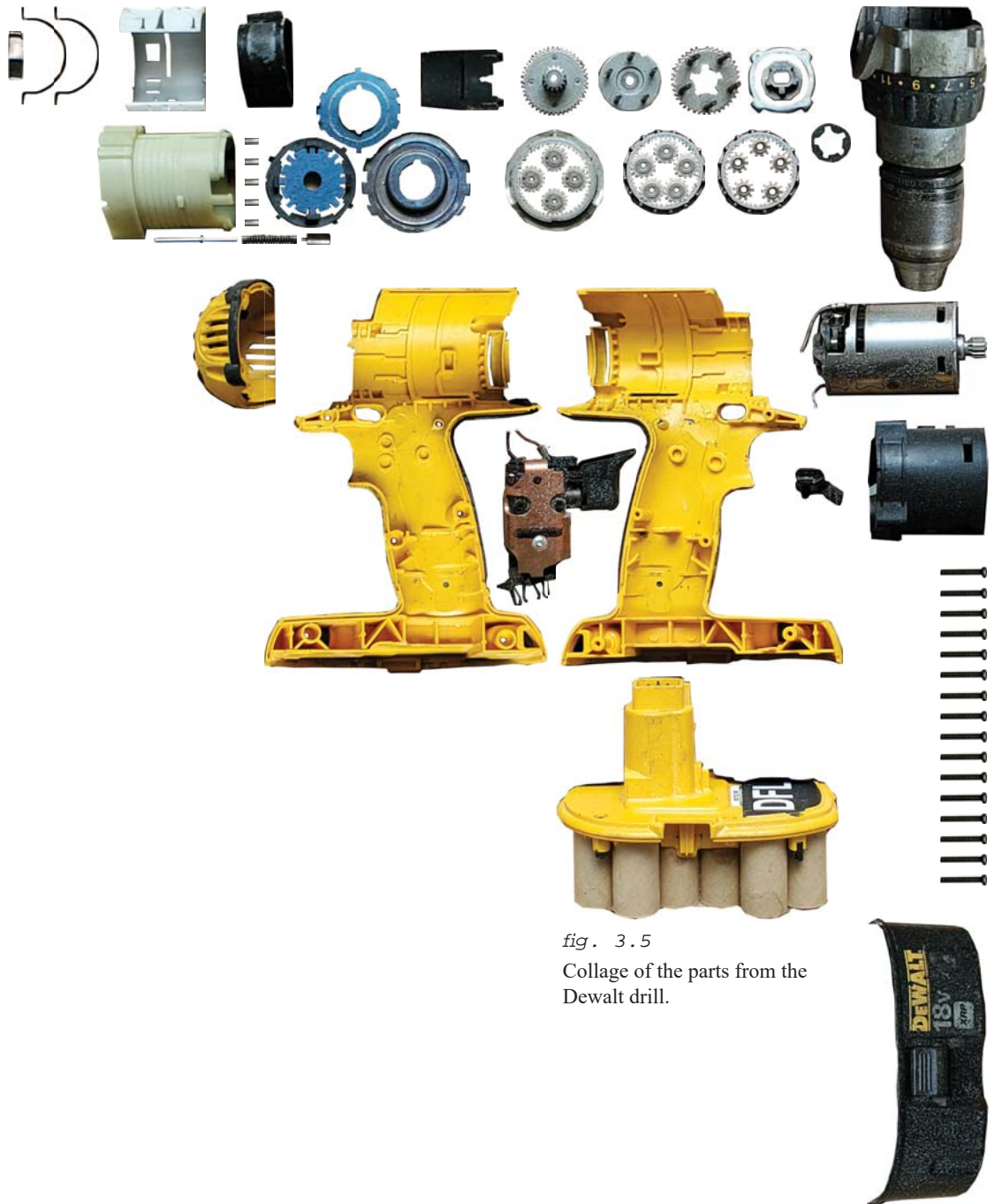


fig. 3.5
Collage of the parts from the Dewalt drill.

10cm
7
5
3
2
1
0

the external battery pack, you can swap the dead battery for a fresh one out of the charger and continue working. The battery in the IKEA drill is a newer 18650 Lithium-Ion cell, which would probably match or outperform the much larger Ni-Cad battery in the Dewalt. Today that battery would be left completely behind by modern commercial grade drills that pack six or more of those same 18650 cells in one removable battery.

Surprising to me was the fact that the IKEA Fixa and the Dewalt drill both share material and construction technologies in their gearboxes. I assumed that at the low price point the Fixa would have a plastic gearbox, hopefully with Nylon gears to give them decent durability. However, when I opened it up I found sintered metal parts, just like in the Dewalt. Sintered metal manufacturing involves pressing metal powders into a mold and heating them up, not to their melting point, but to the point where the grains fuse together. Then the parts are often infilled with additional softer metals, sometimes metals like bronze or brass, which serves to fill the miniscule spaces and can add additional properties like reduced friction. Although this method of making gears is not as durable as machining them from a solid block, it can produce parts much more quickly and cheaply, and is significantly stronger than plastic parts.

Taking apart these drills from different eras gives us insight into a few key things: manufacturing trends, material choices, technological progressions, and design intentions. Although not exactly tools built for the same purpose, they do show how the function of the drill has changed and expanded. The fifties gave us industrial power drills slightly downscaled and modified for at home use. Modern drills are built to perform a wider array of functions from their older corded counterparts, but are certainly not of the same industrial quality.

The first obvious trend is that of manufacturing, which is tied into material choice. Aluminum casting produces beautiful and robust parts that tend to follow the internal components, however, they are expensive to post process, are heavy and are relatively expensive. So it is no surprise that designers fell in love with the ease and variety of form of injection molded plastic, and the cost-efficiency, colour (important for modern marketing), and speed of production that it offers. Both have their merits, but certainly are not equally represented in the market today as plastic completely dominates the landscape. In regard to the housing, we also see a change in the way that it is held together, due to the properties of its material. Aluminum is less flexible, and can be held together from fewer points, but plastics need more support and thus require more screws to do so. Philips head or cross head screws have made this easier by removing the slip

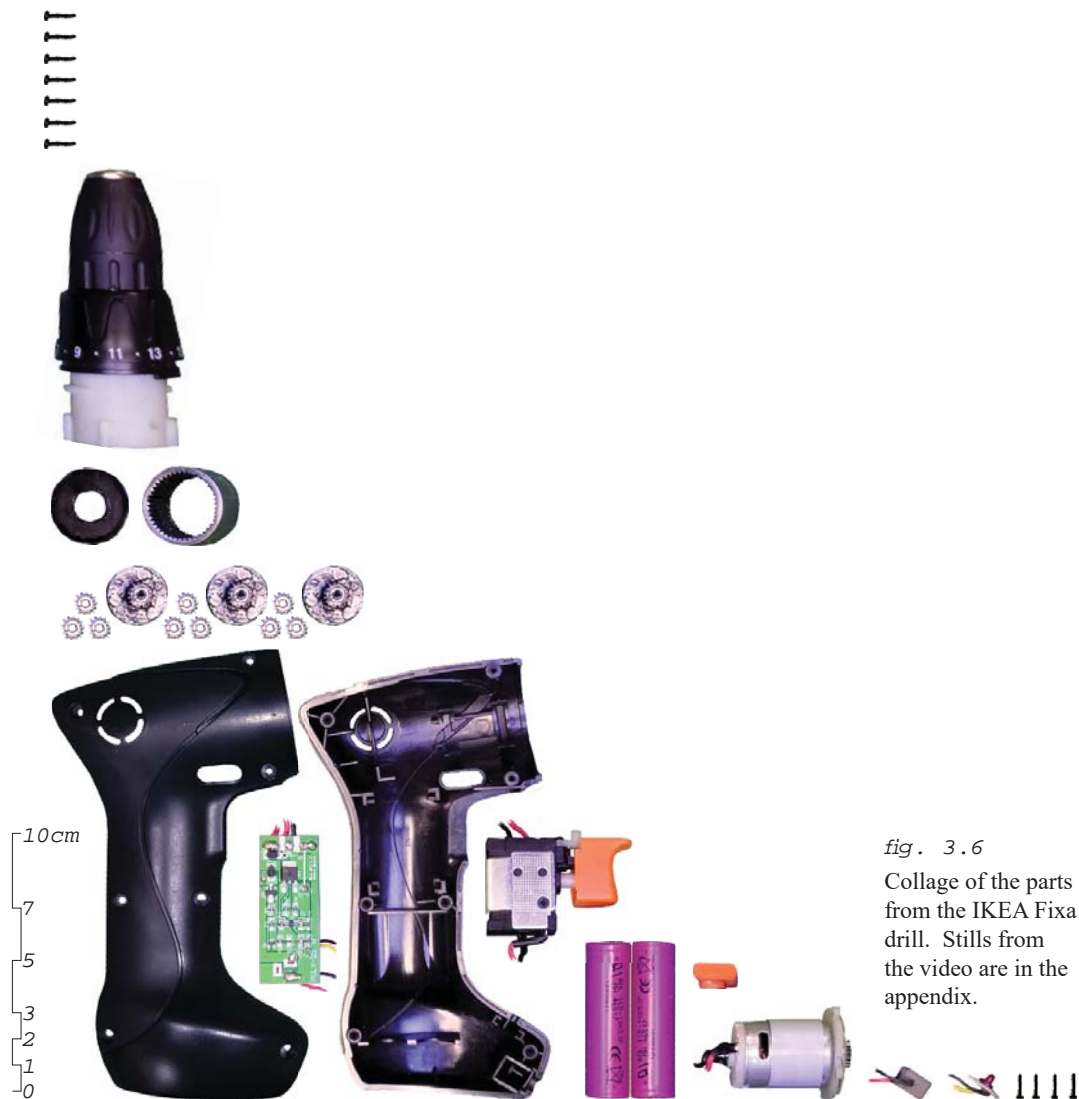


fig. 3.6
 Collage of the parts from the IKEA Fixa drill. Stills from the video are in the appendix.

out that is so common with flat head screws, but this still requires more assembly time. Finally, the gears have gradually transitioned from being machined metal, to sintered metal.

In the area of technology, we see batteries quickly making a huge change allowing these tools to be more flexible with batteries quickly becoming smaller and lighter. The gears also shift from being large and simple to being small and complex, offering greater reductions, which are required to get the same work out of the equally new motors which are smaller and spin faster. The gearboxes also allow for different speeds, hammering, and a clutch to protect the work. This allows for a much greater variety of uses out of the same tool and the variable switch makes this possible.

Unfortunately, in the area of design intentions while we see a shift toward lightness and user friendliness, we also see gradual changes toward greater complexity, lack of modularity and standardization (the additional pipe handle on the Black and Decker being unique among the three drills), and the complete departure from an expectation of maintenance. This is arguably shown most definitively, not in the drills themselves, but in their user manuals.

The Home Utility products (Black and Decker) came with a catalogue showing each of the components and how they went together. The catalogue listed locations of repair centres where you could take your tools to get them fixed or maintained. Both of the newer drills lack this. The Dewalt at least has information available, and exploded drawings can be found online. However, all of the parts are significantly more expensive than their own original percentage of the drill, pointing to the fact that the manufacturer would much rather have consumers simply buy a new drill than maintain their old one. The manual that comes with the IKEA Fixa is basically just directions for how to safely dispose of the battery and throw away the rest of the drill when it is inevitably overworked and is no longer holding charge.

The drill from the fifties had to be maintainable. The people to whom it was marketed would have been familiar with working on their own vehicles and equipment, and they would have questioned anything with moving parts that did not require an overhaul every so often. Maintenance was a requirement, features were developed that made brushes accessible from the outside, screws that could be opened with a butter knife if need be, and directions for obtaining parts or extra help accessible to every tool owner.



fig. 3.7
The final result of the modifications performed on the IKEA Fixa.

RESTORATION AND REIMAGINATION

Having taken the drills apart, I then started on the process of putting them back together. Although it was interesting to have the parts accessible, after having learned what I could from having them apart it made the most sense to restore them back to being functional tools. I had unfortunately already passed on the Dewalt drill, so I was left with only the other two. Both drills were rebuilt, however because of the different findings during their teardowns the rebuild strategy became unique to each of them.

The Fixa had surprised me with the quality of its internal components, but had some major flaws keeping it from being considered *good stuff*. Mainly, I found the internal battery problematic because of the need to stop working with the tool in order to charge it. So, I chose to build an external battery pack for it, which would use the existing 18650 battery cells and basically just piggyback on the body of the drill.

Like in the modifications to the angle grinder in the next chapter, the 3d printer was an indispensable tool, in this instance for creating parts to match to curving geometries rather than specifically working in plastic that could be welded. In adding my battery pack to the exterior of the drill, I chose to avoid plastic welding so that the additional parts could be removed. This was accomplished by adding wooden blocking inside of the drill body and using screws to attach the external pack to the blocking. In doing the modification this way, I maintained some ability to revert back to the original drill, with a few additional holes of course.

Apart from the creation of the battery pack, the only real requirement was desoldering (removing the low temperature joining metal for electrical connections) the existing battery leads from the control board, cleaning up the batteries, and marking their polarity. This modification became more of an exercise in 3D modelling new parts to work with existing ones, rather than practice in using workshop tools to modify or strengthen the existing parts.

Rebuilding the Black and Decker drill took on a different approach than either the angle grinder or the Fixa. Although the drill has arguably fallen victim to technological obsolescence, it is still a great, robust tool and it still performs well for what it was designed to do. So, rather than try to modify it, adding a 120 volt battery pack or removing parts of the casing to make it lighter, I simply opted to restore it.



fig. 3.8
The final result of the
refinishing of the Black &
Decker drill.

The age of the drill meant that the main operation in restoring it was actually cleaning it. Cleaning can really be the foundation of all maintenance and repair work, and in many cases is all that is needed to get something working in new condition again. In this drill, removing the old paint, cooked grease, crumbling cloth insulated wires, and ground down carbon brushes was the goal, replacing them with new components. Care had to be taken in the removal of the paint because of the likelihood of it containing lead; I wore a respirator and tried to avoid kicking up any dust. The crumbling insulation really needed to be dealt with because of the nature of the tool; its aluminum body is ready and willing to deliver mains voltage into the user if any connections short and the grounding wire fails. I replaced this with flexible silicone insulated wire that should last a very long time and withstand vibration and heat without a problem. Finally, the old grease was scooped out and cleaned up with some solvent, and new grease was added to ensure that everything would run smoothly for years to come.

Replacing the carbon brushes was the biggest challenge. The brushes are the component that transmits power from the unmoving portion of the drill to the moving part of the motor, called the rotor. They run along an armature, a series of copper contacts that correspond to the windings on the motor and allow the creation of magnetic fields that drive the motor when electrically charged. Back when this drill was designed, they used an imperial measurement for the brushes. However, modern graphite (the form of carbon used to make these components) brushes are only commonly available, at least in Kitchener-Waterloo region. Fortunately, RMW Electric, who specialize in repairing contractor tools and for who replacing brushes is a routine task, gave me some advice: First, to simply sand down the set of larger brushes that I purchased from them to size, and second, to sand the face of the old brushes and use them as a follower for the new graphite, removing the new springs that were a different size. This ended up being an extremely simple and successful solution, and goes to show that it is definitely worth asking advice from people more experienced than you when you have the opportunity to.

Both the IKEA Fixa and the Black and Decker Home Utility got the same multi-colour spraypaint treatment as the angle grinder did, showcasing their unique parts. In the case of the Black and Decker, if I had the time I would have preferred to polish the aluminum casing and leave it bare, as well as rebuild the etched brass nameplate, as this would have celebrated the materials it was made from. As it stands, the colour scheme helps the three tools to feel like a set, and ensures that I will not be mixing up my tools with those of anyone else.



fig. 4.1 The Workbench

THE ANGLE GRINDER

WELL BUILT BUT MISUSED

An angle grinder may not be the most popular item in most shops or households, but it a versatile tool that can be used for a variety of jobs that include cutting, grinding, deburring, finishing and polishing. This specimen was a broken angle grinder that someone sent my way after finding my Kijiji ad looking for broken things to take apart. It is a JobMate four and a half inch grinder, and was probably sold at Canadian Tire over ten years ago as their in-house base level brand. I will preface this with the fact that this is not an example of *good stuff*, but it does have a few valuable lessons that can be taken away from its teardown.

Even before opening the angle grinder, we can infer a few things. It has a substantial amount of weight, the exterior at the working end is made of metal, and the visible screws are regular Phillips screws, not security screws! The plastic body feels solid and has the distinct crunching of fiberglass reinforcing when cut with a knife, showing that the manufacturer did not cut corners on their injection molding blend. This bodes well for starting out. We can also begin to make some assumptions about what caused it to fail. The layer of ceramic dust points to someone likely misusing it as a tile saw, without the proper equipment to manage dust. It is by practicing maintenance and repair that we learn to see these signs.

Starting disassembly, I found that the Phillips screws are sized correctly. They are big enough that you can exert the required torque to unstick them without stripping the head, also indicating the use of good material. Moving through the disassembly, all the screws, regardless of their length and whether designed for plastic or metal, have the same head. This makes the assembly easier for the manufacturer, and the disassembly and maintenance more pleasant for the buyer.



fig. 4.2
Collage of the parts of the Angle Grinder. Stills from the video are in the appendix.

Unfortunately, not all the parts are held together with these screws. Some of them are slide fit, which is great for assembly but can be a little bit difficult to decipher during disassembly. The trigger was snap fit, using detailed injection molded plastic components that fit into each other and lock into place. It came apart happily this time, but there are a limited number of times that it can be taken apart before it will break. Snap fit connections are also prone to break during disassembly, because they are typically designed to be assembled only once. Finally some parts, namely the brush holders, are unfortunately welded into the plastic. Luckily they are not mechanical or wear items, but at the very least they will make the product difficult to recycle when they are discarded.

Looking at the motor winding, the wires are all epoxied together to give them longer life, protecting them from vibration and moisture ingress. The rotor of the motor, (the core with the windings which rotates) is balanced by grinding away material rather than gluing on weights, which also tends to last longer. The bearings in the motor assembly are sealed, and the bearing on the end of the shaft has a rubber jacket to dampen any vibration and account for any flex in the body of the tool.

At the other end of the rotor there is a fan to keep everything cool. At the working end of the tool are the gears which reduce the speed of the rotor to the working speed and change the output angle. These gears are made of metal, and are machined rather than sintered. This means that they are made from solid metal, rather than the metal made by squishing and melting together a metal powder¹. This leads to stronger parts and smoother gear meshing. Overall, the actual working motor assembly on this tool is great.

DESIGN FAILINGS, OR DESIGNED LIMITATIONS

There are some areas where the motor assembly does not score as well. First, the grease seems to have cooked, which will happen over time but also means that there is room for improvement for the manufacturer to put in better grease during assembly. Secondly, the assembly of the motor and gears is extremely difficult to disassemble for people at home. I had

¹ Wikipedia. 2020. *Metal Injection Molding*. December 23. Accessed February 11, 2021. https://en.wikipedia.org/wiki/Metal_injection_molding.



fig. 4.3
Comparison of new and worn graphite brushes of different sizes.

to go through C-Clips – little bits of metal that need specialized pliers to be removed. They can launch themselves across the room or into your eye so this becomes a safety concern. As of yet, I have been not been able to decouple the gears from their shafts, as they have either been press fit or shrunk fit. Applying more force might solve the issue, but doing so would cause worries about breaking other parts of the assembly.

Finally, the main thing that I found problematic in this tool was the location of the brushes. The brushes are a part of the motor assembly that transfers electrical current to the rotor. They are made of soft graphite because they slide along a rapidly spinning contact area, and graphite is a self-lubricating and conductive material. However, graphite self-lubricates by riding on a layer of graphite dust, meaning that these brushes are wear items that need to be replaced throughout the life of the tool. They also wear out increasingly quickly when harder dust (like ceramic dust) gets into the contact area. The main failing of the design of this grinder is that the brushes are not accessible, and therefore cannot be replaced from the outside of the tool. This means that when these two miniscule wearing parts eventually need to be replaced, the tool appears to be broken, and an inexperienced user will likely throw it out and buy a new one rather than perform the required maintenance.

Overall, this tool is surprisingly well built for an entry level brand. Unfortunately, to separate it from the higher level tools it looks like they made the design decision to make the areas required for maintenance much more difficult to access. This creates the likelihood that the tool will end up as trash and the customer will buy another one. As an act of design, this goes against common sense; however, when produced by a company that seeks to gain monetary profit and sees the creation of waste goods as an acceptable cost to doing business, this becomes the norm for bottom tier products.

A global market that puts so much space between manufacturers, distributors, and end users makes it easier for manufacturers to make sub-standard products. That much distance between the origination of an item and its final destination makes it simpler for sellers to ignore buyer complaints. But as designers, we should avoid accepting these kinds of nefarious design motives and make things more open to end users. And as end users, we can look for ways around these shortcomings to hopefully breathe new life back into stuff that was designed with a built-in lifespan.

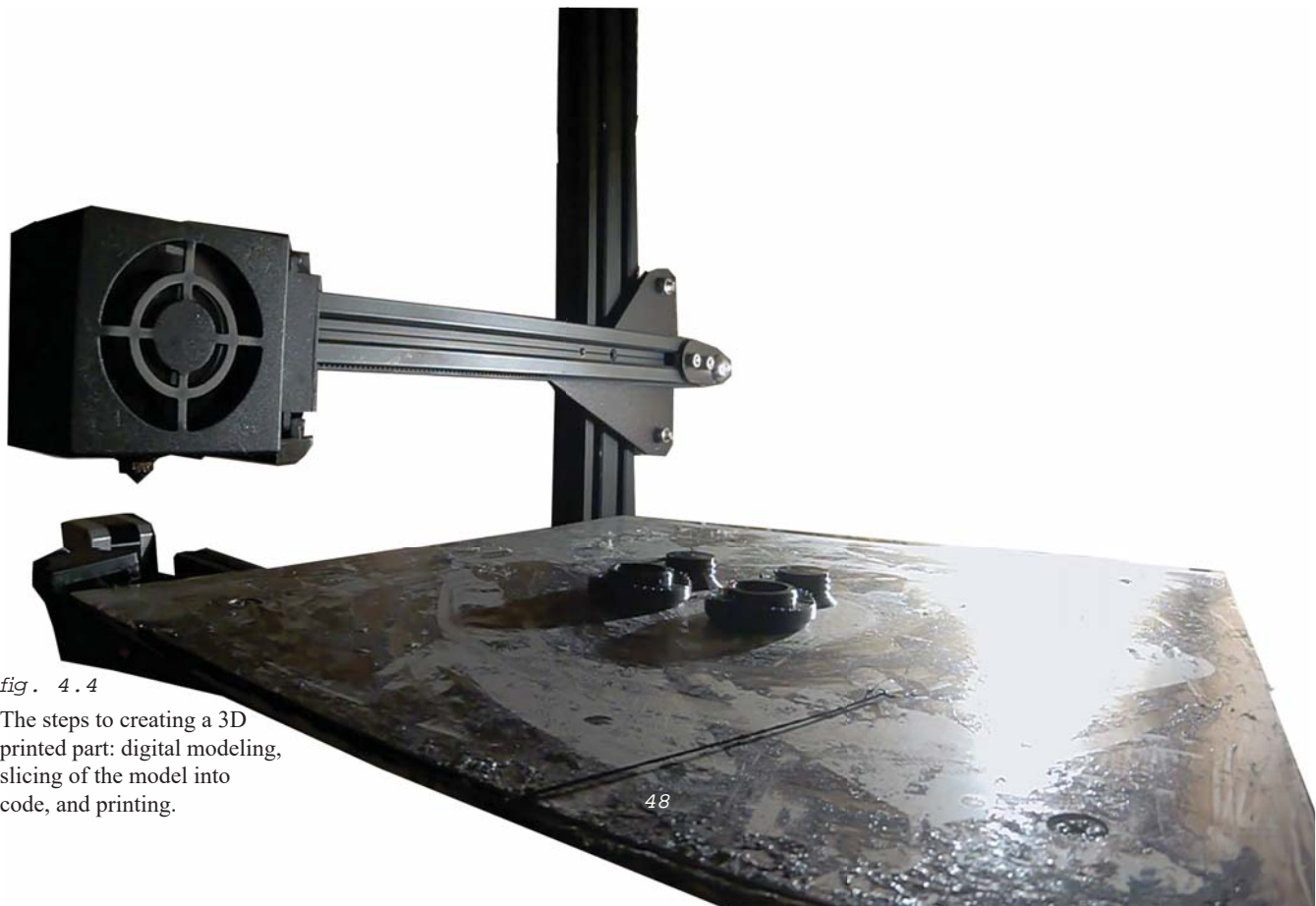
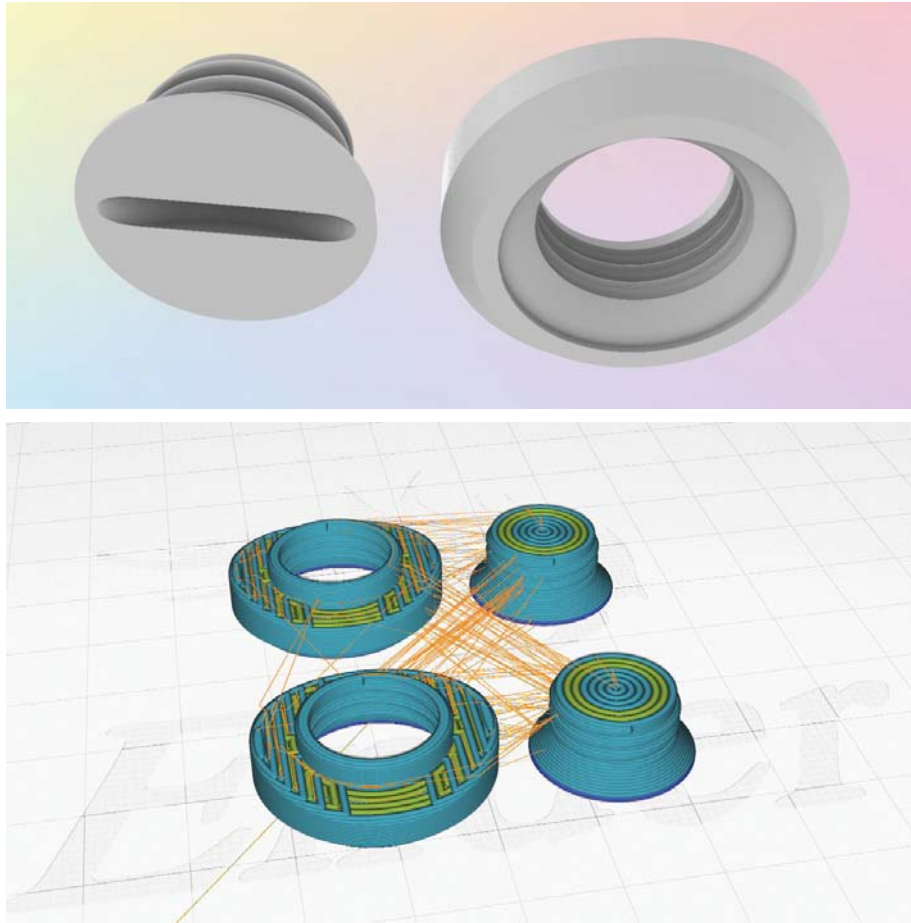


fig. 4.4
The steps to creating a 3D printed part: digital modeling, slicing of the model into code, and printing.

TURNING A FREE TOOL INTO GOOD STUFF

After taking apart the grinder and seeing how most of it was built well, the apparent next step was rebuilding it. However, I did not want to simply take the route that I usually would to fix it by replacing the broken or worn part (in this case the brushes). That would still leave the grinder in a state that would be difficult to repair. So, I set out to modify the design of the brush holders and the access to them to make this task simple for future repairs.

The first step was figuring out how to modify the plastic casing to allow access without taking the whole cover apart. We have another angle grinder in our workshop. This green Hitachi branded grinder has large screw-in plastic inserts that can be turned with a coin or a standard blade screwdriver to access the brushes. I chose to copy the general design of these. After marking where the brushes sat when the case was closed, a drill made quick work of boring out holes overhead.

Creating the screws was the major part of the modification which fortunately was made relatively simple by access to a 3D printer. The screws and sockets were modelled in Rhino 3D to create a digital geometry, and then that geometry was run through Cura. Cura is a slicing program freely distributed by Ultimaker for use with their 3D printers, but it can be set up to work with a variety of other printers. The role of the slicer is to effectively “slice” the digital geometry of the parts and turn it into paths that can be extruded in plastic, and exporting those paths into gcode, a type of computer code that is commonly used for controlling CNC machines, like 3D printers. I printed the parts in ABS plastic because this plastic has a high heat tolerance and is electrically insulating, which is important because the brushes will heat up and also be connected to one hundred and twenty volts alternating current. I believe that the base plastic of the grinder is also an ABS blend, which allows the new printed parts to be attached by welding them together.

The beauty of the 3D printer in this case is that it allows an otherwise unavailable set of parts to be customized to the particular application and printed in about thirty minutes, much faster than it could ever be delivered from a supplier even if it was available. The ability to quickly work in plastic is mainly what makes this modification possible. Without the ability to work in the same material of the original case, it would be tough to build parts that meet the same heat and insular requirements while still allowing them to be robustly attached to the body of the grinder. I could resort to

fig. 4.5
Labels



LET'S
MAKE
GOOD
STUFF



building it in wood and epoxying it on to the grinder, but it is difficult for me to trust a glued joint compared to a weld, no matter how good the glue.

The other mechanical part of the modification was working on the brush holders. The graphite brushes that were supplied with the grinder are unique, ones with the clip built into the brass spring-end. This is a non-standard detail and is not a part for which I could find a replacement. However, a commonly available brush type was available with the same size brush, just with the more standard flat brass spring-end that does not clip itself in and relies on an external clip instead. That was fine, because my external access ports would hold the brushes in place now, but the springs on the standard brushes are also larger than the supplied ones. To fix this, I used another angle grinder (there is a lesson here about always having a backup of the tools you use often) and a cutoff disk to remove material in the center of the brush holder, making space for the larger springs.

Before I cut the material away, I reinforced the brush holders with a few tack welds. This was relatively simple, because the brush holders are steel. But it was made slightly more difficult by the fact that the holders that were permanently affixed to their part of the plastic casing, which caused the plastic to catch fire briefly a few times when the welding heated up the brush holder.

These two changes that I introduced to the design allow the angle grinder to accept commonly available brushes, and make it easy for the operator to replace them with using a standard blade screwdriver, a coin or even a key if a screwdriver is not around. Other than the mechanical changes, I took the step of spray painting many of the individual parts to highlight the assemblies of the tool, showing that the plastic clamshell is not continuous, but in fact made up of multiple parts. Although this does not really create additional utility, and in fact might wear off relatively quickly with use, it makes it easier to see the tool as an amalgamation of components and celebrates the fact that it can, in fact, be taken back down into those individual components.

I do not want to suggest that everyone go out and modify a tool for the sake of using it. Most of the steps that I took were not at all necessary to make the angle grinder work again, but were done to make it easier to service and to barely get it into the category of *good stuff*. By all means, if you have access to broken tools that can be repaired and you want to use them, go for it! It will be a learning experience and will leave you



fig. 4.6

The final result of the modifications to the angle grinder.

with something useful. And if you want to modify it there is benefit to that too, but it quickly becomes costly. With the structure of this thesis I am afforded the time to take on the experiment of modification, however, under the time and cost requirements of personal or professional work I would simply be changing the brushes and getting back to work.

The additional exercise of turning it into something that I would consider *good stuff*-something that in this case works well for what it was intended and is easy to service and maintain to keep it working well- is intended to show that it *can* be done. There was very little that the manufacturer would have had to do when originally building this tool in order to extend its lifespan rather than expecting it to end up in the trash in less than ten years. It probably would cost them less than two dollars per unit at their production to change the molding and include slightly higher quality brushes and brush holders, and they could easily recoup that by justifying a higher retail price. However, that decision was probably avoided to make more differences between this bottom tier tool and the higher quality tools that presumably had been designed with replaceable brushes. Without that difference, why would a consumer choose to purchase the more expensive tool? This artificial segmenting of the market to justify different price points, and the way that it is imposed on the products produced, is extremely problematic.





fig. 5.1
Tool Collage

CONCLUSION AND REFLECTION

ENGAGING THE WORLD THROUGH DESIGN

This project has been an opportunity for me to more closely examine the physical reality of the artifacts of design. Choosing to investigate tools and particularly drills, products made to give people agency over the material world around them, has given a specific focus and meaning to the work. These tools, and other products of design, can empower people to have greater agency in the world around them. These are not objects designed only to benefit a person's experience with aesthetic, they are meant to do real work in a real world. However, this core purpose of these tools is often subverted, at least in modern tools, by odd choices on the designer's part. Choices that make something useful guaranteed to become useless, unless rather drastic changes are made by others.

Learning to make these changes in tools that are not meeting the mark has been something of an exciting challenge as a designer. Learning to work within the existing framework of the product, with its parts, and especially with compatible materials, has been an opportunity to stretch my own knowledge and ability. Making modifications to allow tools to meet my requirements, and hopefully the requirements of whoever uses it next (and to also allow the tool to last long enough to be passed on to someone else) has been an interaction with the original intents of the designer and the company that produced the tool. While taking something apart teaches about the history, the material, the method of manufacturing, as well as the successes and failings of the product, it is the repair or rebuilding that allows our own intervention and for our own creativity to turn that learning into well-informed work.

As designers, my own experience has been that there is a pull to always creating a new design solution. After all, the creation of a new product is what we are trained in and our interest in creating things is probably what

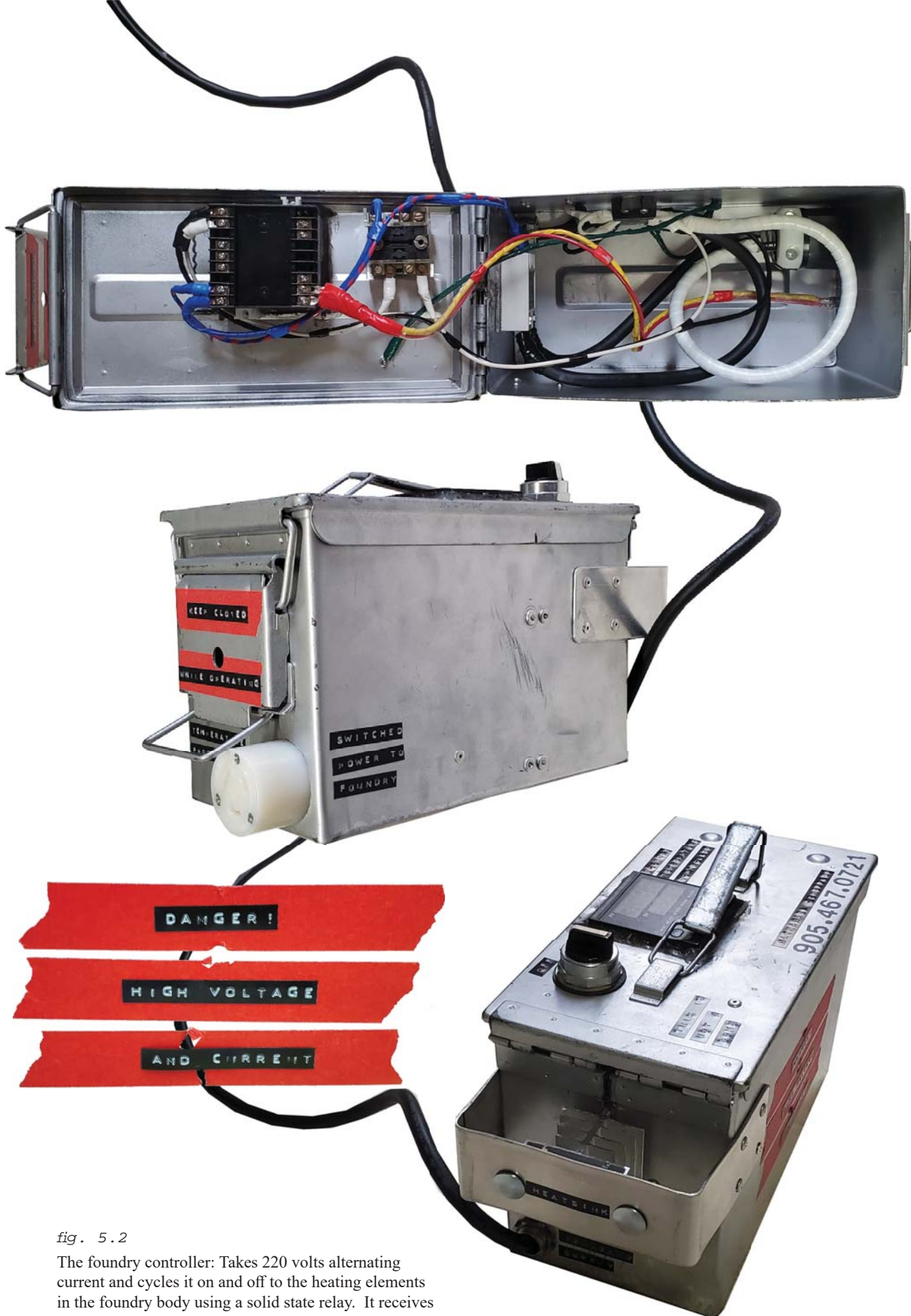


fig. 5.2

The foundry controller: Takes 220 volts alternating current and cycles it on and off to the heating elements in the foundry body using a solid state relay. It receives temperature feedback from a probe in the foundry.

led us into the field of design. However, there is a lot to be gleaned from the past, both in design lessons through researching historical patents, drawings, and documents, but also in the physical reality of those objects. When we engage in repair and maintenance work with older objects we create new and rich opportunities for design that extends object lifespans and also has potential to expand on the features and friendliness of those objects by injecting updated technology.

HURDLES OF DESIGN THINKING

I am myself guilty of pursuing the drive to design anew rather than seeking solutions in existing frameworks. For a large portion of this thesis I overlooked the potential within existing objects and tried to work at the largest loop of the technical nutrient cycle, recycling.

Inspired by the Precious Plastics Project¹, I sought to create a toolset for myself to work hands on with a material that had previously been mostly limited to industrial use. I wanted to create ways to work with aluminum, pulling my raw materials out of household waste streams to create new products that were able to be indefinitely cycled, creating a loop of recreating and recycling.

This type of work also challenged me, however those challenges were more in the realm of ensuring electrical and fire safety, managing to get enough power out of the breaker box, and continually repairing components that burned themselves up or melted together. I would argue that this type of work, the creation of tools that allow a means of small-scale production and recycling for individual designers or small collectives, is very important to making design more sustainable and accessible in the future. However, my own experience in building an aluminum foundry speaks to how much more efficient it is for an individual to work at the scales of maintenance and repair.

Getting over the drive to design something new was something of a matter of ego and a matter of efficiency. In my mind, it was easier to start from scratch, and then I would have full control over every part of the design, both of function and aesthetic. Choosing to work within existing frameworks, to repair and modify tools and products that are already in the

1 Hakkens, Dave, and al. 2013. *The Precious Plastic Project*. Accessed August 8, 2018. <https://preciousplastic.com/>.

fig. 5.3

The foundry controller and foundry body connected and in use, the tongs used to manipulate the crucible, the ingot mold, a poured and overflowing ingot, and a final stamped aluminum ingot.



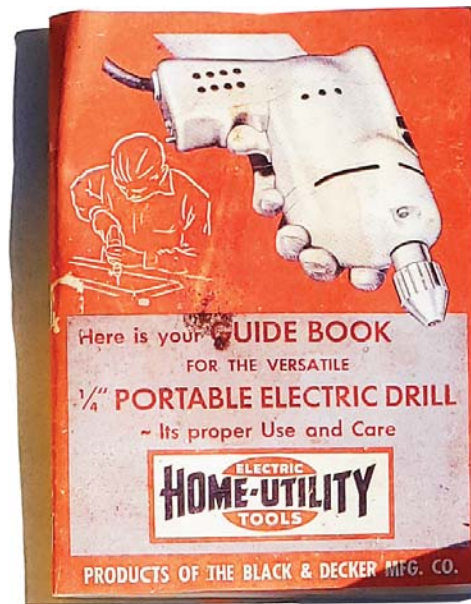
world, forces the designer to give up an aspect of control over their work, as well as to meet the additional challenge of working with something that might not be ideal for their purpose. Although it can feel limiting at first, it can end up being an opportunity for greater impact as it engages with history and protects our collective future through the stewarding of our existing resources.

EDUCATION AND RESOURCES

One of the difficulties for people wanting to engage with this type of hands on work is the barrier to entry. To some extent this can be a perceived barrier, simply a level of comfort around opening things up and risking potentially breaking them. This is a real barrier that needs addressing, because without the understanding that we can engage in maintenance and repair work we simply will not take part in it. I am fortunate to have a family who has been significantly involved in repairing and making things, and to have attended elementary schools and a high school that still had classes that engaged students in designing and building, as well as construction skills, as well as to have attended college classes to hone my welding skills. I have essentially been continuously brought up in an environment that taught me a very real way to engage with the physical world around me, and as such has developed my own personal agency in this arena.

This is not the case for everyone. If you did not have a parent, grandparent, or aunt or uncle who taught you how to make sew, knit, weld, frame, paint, weave, change a car's oil, or dismantle a hand mixer, these things would have been difficult to explore by yourself at a young age. And if your schools did not provide opportunities to explore and learn in these areas in your youth, where would you learn them, or even be exposed to them? Matthew Crawford's critique of the lack of technical education in schools, due to core curriculum shifting to uphold other parts of the economy as manufacturing declines in North America, is that it robs us of the critical thinking skills that go into this middle area of maintenance work². Math and Sciences always have a straight answer; for the most part you seem to be wrong or right, unless you are pushing boundaries in theoretical work. Language and Arts classes on the other hand never seem to have

2 Crawford, Matthew B. 2009. *Shop Class as Soulcraft: An inquiry into the value of work*. New York: Penguin.



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THE WORLD'S BIGGEST SHOW & TELL

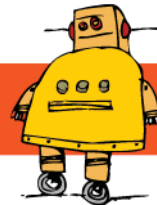


fig. 5.4

Where the user manual used to be the main source of information about a tool or product, online forums and user guides created by individuals fill the gaps often left in the information provided by manufacturers today.

an exact correct answer, but really approach a spectrum of solutions and explorations. Design work often seems to fall into this latter set in its perceived flexibility. But maintenance and repair, and design with existing objects, seems to fall somewhere in between. There is a right answer, in that the thing should work in the end, but there is a degree of freedom in deciding how to go about getting it to work. The answer is not always clear, and that is where the inherent challenge lies, and the potential for our greatest growth as designers.

Making this type of education more accessible to people is important in overcoming the barrier of unfamiliarity. Resources like those I have already mentioned, iFixit³ and Instructables⁴, are useful for people who already have an idea of what they are looking for and know how to look up the specific instructions for what they hope to accomplish. At the starting stages though, even knowing what to look for can be a challenge. However, easier connection to people through the internet, particularly social media and video sharing platforms like YouTube⁵, offer an opportunity to engage with people who might not otherwise approach disassembly or repair projects themselves. Short videos showing how things come apart and how they work on the inside is what I see as the easiest and most engaging way to get someone else to say: “Maybe I could do that!”. To that end, the main format that I worked in throughout the teardown and rebuild portion of the thesis was through video work, recording and editing the process of disassembling and reassembling with a voiceover to explain what I was doing. The video work to date can be found on my thesis website, www.letsmakegoodstuff.com⁶, and I plan to continue to expand upon it.

The other very real barrier to entry to this kind of work is that of actually having access to the tools and materials that is required. If you do not have the benefit of being able to use a basement workshop, or do not already have a collection of tools ready to be put to work, taking on repair work can become even more daunting. Although I would argue that it is useful for everyone to have access to a basic set of tools, sharing organizations like the Toronto Tool Library⁷ offer an alternative route. Tool libraries offer, for a membership fee and often an additional rental fee, access to a wide variety of tools and equipment that would otherwise be very costly, both monetarily and from a storage point of view, for an individual to maintain.

3 iFixit. 2003. *About Us*. Accessed November 18, 2019. <https://www.ifixit.com/Info/index>.

4 Instructables. 2006. *Our Story*. Accessed January 15, 2009. <https://www.instructables.com/about/>.

5 YouTube. 2021. *About YouTube*. Accessed January 14, 2021. <https://www.youtube.com/about/>.

6 Scheffler, Nathanael. 2020. *Let's Make Good Stuff*. December 10. Accessed December 10, 2020. <https://letsmakegoodstuff.com/>.

7 Toronto Tool Library. 2012. *About Us*. Accessed September 20, 2020. <https://www.torontotoollibrary.com/about-us>.



fig. 5.5
IKEA Fixa Collage

Sharing resources in ways like this allows access to higher quality tools as the cost is split, and often also comes with the benefit of connecting members to people who have good advice and experience to offer. Groups like these also often partner with Makerspaces, which help to overcome the barrier to entry for more specialized equipment like workshop tools, 3d printers, lasercutters and CNC machines, and also provide people living in the city a place to work on larger projects. Public libraries are even stepping in in many places to offer services like this; in Cambridge the newly renovated Old Post Office across from the School of Architecture has a makerspace that offers people with a library card access to a variety of hand and digital tools⁸. Repair cafes are also gaining popularity, events where people can bring broken appliances and household items to learn how to fix them, typically with the help of volunteers. The creation of community resources like these creates spaces for people to access equipment, connect with other people who want to learn, and to be taught by people who have experience to share, and can enable learning for a whole new generation of people who have not had access to resources like these through current school curriculums.

LIMITATIONS AND OPPORTUNITIES

Just as nostalgia can begin to hold us back if we begin to uphold stuff simply because it is old rather than it being good, not allowing for natural progression to take place, maintenance and repair also have their limits. At some point there is a diminishing return when repairing something; either a new item that do the job better is available at a justifiable cost, or the original item is so outdated that it is no longer good enough at doing its work to justify repair. The knowledge of how far to take maintenance or repair work is something that requires time and practice to build up, and even then new difficulties that arise during the work like broken bolts or stripped screws eat up unexpected time and quickly put a project into the red. In the repair, restoration, and modification work that I undertook in my thesis, the Black and Decker drill is the only project that I would not label as completely gratuitous. Both the Fixa and the angle grinder could have been much more easily and cheaply replaced with alternative solutions that would probably work better in the long run, however because of this being thesis work I am afforded extensive time to experiment and learn.

⁸ Idea Exchange. 2018. *Old Post Office Makerspace*. Accessed January 13, 2021. <https://ideaexchange.org/oldpostoffice/makerspace>.



fig. 5.6
Angle Grinder Collage

Although repair is not always a feasible solution, we are not left wanting. There is still opportunity to engage in upper levels of the circular economy like recycling, turning that object back into its raw materials so that it can be reformed into something new. Although the foundry project is not complete at the time of writing this thesis, it is still a part of this project that I intend to explore and utilize. If, as designers, we can play a role in making sure that that object is better able to exist within the technical nutrient cycle, creating tools for myself to work within that cycle is important to me. By engaging with repair work as well as design work, we can better confront and engage the physical reality of our creations. Similar to the hands-on importance of creating physical models and mock-ups of new designs, engaging in the designed world helps us to expand our own knowledge of parts, processes, and standards, giving us a greater ability to think of comprehensive solutions. When we engage in maintenance and repair, we will already be primed for that type of thinking in our own designs; we will inherently be making them easier for people to take care of them down the road because we will be dreaming them up with maintenance and care in mind.

When design is approached in this way, through a lens of the holistic experience of that object rather than just aesthetic aspirations, things that could be seen as challenges to manufacturers become opportunities. Meeting Cradle to Cradle Certification⁹ requirements is no longer a sourcing nightmare, but an opportunity to make sure that you can reclaim the materials of your products and reuse them later rather than paying high prices for new material. Meeting Right to Repair legislation¹⁰ is no longer divulging trade secrets or diminishing your downstream repair revenue; it is striving to make your products as good as they can be, accessible inside and out, benefitting your clients and making your assembly more manageable with modular components that are easily put together. Utilizing open source¹¹ or creative commons licenses¹² rather than locking everything down under patents is not opening yourself up to intellectual property theft, it is allowing your work to benefit as many people as possible while making it open to as much feedback and community engagement as possible. The additional time used in creating proper documentation and user manuals is not an unnecessary expense, but a core piece of your design work that ensures the most positive end user experience possible.

9 McDonough, William, and Michael Braungart. 2009. *Cradle to Cradle: Remaking the way we make things*. London: Vintage.

10 The Repair Association. 2021. *Working Together to Make Repair-Friendly Public Policy*. January 1. Accessed January 13, 2021. <https://www.repair.org/legislation>.

11 Peterson, Christine. 2018. *How I coined the term 'open source'*. February 1. Accessed January 13, 2021. <https://www.opensource.com/article/18/2/coining-term-open-source-software>.

12 Creative Commons. 2013. *About The Licenses*. January 1. Accessed January 14, 2021. <https://creativecommons.org/licenses/>.



fig. 5.7
Black & Decker Collage

This thesis has been an opportunity for me to explore what it looks like to work within the framework of repair and modification rather than starting with a blank slate, and it has broadened the perspective of what my own practices of design might look like. I hope that this work can be an encouragement to designers, and people who just want to further engage with their belongings, to be developing their own practices of investigating the things around them in greater depth in order to take better care of them.

I hope that it inspires you, the reader, who I thank for taking the time to review my work, to get out there and make *good stuff*.

BIBLIOGRAPHY

- Barkho, Gabriela. 2020. “‘In a sweet spot right now’: Legacy crafting retailers and brands are seeing new signs of life.” Modern Retail. November 17. Accessed February 11, 2021. <https://www.modernretail.co/retailers/crafting-diy-hobbies-gain-momentum-as-the-pandemic-continues/>.
- Batchelor, Bob. 2021. “The Development of Mass Production Has a Dramatic Impact on Industry and Society.” Encyclopedia.com. February 1. Accessed February 12, 2021. <https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/development-mass-production-has-dramatic-impact-industry-and-society>.
- Black, S. D, and A. G Decker. 1917. Drill Gearing. US Patent 1229401. June 12.
- Black, S. D, and A. G Decker. 1926. Electric Cord Protector. US Patent 1574020. February 23.
- Black, S. D, and A. G Decker. 1929. Electrical Connection For Portable Electric Tool. US Patent 1702245. February 19.
- Black, S. D, and A. G Decker. 1924. Electrically Driven Tool. US Patent 1492095. April 29.
- Black, S. D, and A. G Decker. 1921. Portable Electric Tool. US Patent D57576. April 26.
- Black, S. D, and A. G Decker. 1929. Portable Tool. US Patent 1699870. January 22.
- Black, S. D, and A. G Decker. 1925. Reversing Means for Electric Tools. US Patent 1548020. August 4.
- Black, S. D: Decker, A. G. 1917. Electrically Driven Tool. US Patent 1245860. November 6.

- Brown, Lester R. 2001. *Eco-Economy: Building an Economy for the Earth*. New York: W.W. Norton.
- Crawford, Matthew B. 2009. *Shop Class as Soulcraft: An inquiry into the value of work*. New York: Penguin.
- Creative Commons. 2013. About The Licenses. January 1. Accessed January 14, 2021. <https://creativecommons.org/licenses/>.
- Decker, A. G. 1936. Bench Drill Stand. US Patent 2038422. April 21.
- Decker, A. G. 1927. Portable, Power Driven. Rotary Tool with Spindle Latch and Hand Operated Chuck. US Patent 1649060. November 15.
- Decker, A. G. 1927. Rotary Tool with Key Pocket. US Patent 1647396. November 1.
- Evans, Pete. 2020. "Retail sales plunged, but online shopping soared as COVID-19 settled in in April." CBC. June 19. Accessed February 11, 2021. <https://www.cbc.ca/news/business/retail-sales-april-1.5618839>.
- Garvin, David A. 1983. "Quality on the Line." *Harvard Business Review*. September. Accessed January 5, 2021. <https://hbr.org/1983/09/quality-on-the-line>.
- Gibbs, Samuel. 2018. "Apple and Samsung fined for deliberately slowing down phones." *The Guardian*. October 24. Accessed February 10, 2021. <https://www.theguardian.com/technology/2018/oct/24/apple-samsung-fined-for-slowng-down-phones>.
- Hahn, Jennifer. 2019. "EU recognises "right to repair" in push to make appliances last longer." *Dezeen*. October 1. Accessed October 14, 2019. https://www.dezeen.com/2019/10/01/eu-right-to-repair-design/?fbclid=IwAR0MtiBhhVEZG4LgSxduYfvMUZmJWHdUNOAqUX62OXZaVRYk-fqi_eVa-Sw.
- Hakkens, Dave, et al. 2013. *The Precious Plastic Project*. Accessed August 8, 2018. <https://preciousplastic.com/>.
- Hansen, Hans. 1988. "Photograph of a Disassembled Golf CL." Fotomuseum. Im Auftrag der Volkswagen AG, Art Director Dietmar Meyer. Germany.
- Harrabin, Roger. 2019. "EU Brings in 'right to repair' rules for appliances." *BBC*. September 30. Accessed January 14, 2021. <https://www.bbc.com/news/business-49884827>.

- Idea Exchange. 2018. Old Post Office Makerspace. Accessed January 13, 2021. <https://ideaexchange.org/oldpostoffice/makerspace>.
- iFixit. 2003. About Us. Accessed November 18, 2019. <https://www.ifixit.com/Info/index>.
- Ingraham, Christopher. 2021. “World’s richest men added billions to their fortunes last year as others struggled.” Washington Post. January 1. Accessed February 11, 2021. <https://www.washingtonpost.com/business/2021/01/01/bezos-musk-wealth-pandemic/>.
- Instructables. 2006. Our Story. Accessed January 15, 2009. <https://www.instructables.com/about/>.
- Kinchin, Juliet, and Andrew Gardner. 2019. “The Value of Good Design.” MoMA. Accessed November 16, 2020. <https://www.moma.org/calendar/exhibitions/5032>.
2007. The Story of Stuff. Directed by Annie Leonard, Louis Fox and Jonah Sachs. Performed by Annie Leonard.
- Lewis, Kemper, Deborah Moore-Russo, Omar M Ashour, Timothy W Simpson, Gul Kremer, Xaver Neumeyer, Ann F McKenna, and Wei Chen. 2011. “Teaching the Global, Economic, Environmental, and Societal Foundations of Engineering Design through Product Archaeology.” 118th American Society for Engineering Education Annual Conference and Exposition. Vancouver.
- McDonough, William, and Michael Braungart. 2009. *Cradle to Cradle: Remaking the way we make things*. London: Vintage.
- . 2013. *The Upcycle*. New York: North Point Press.
- McLellan, Todd. 2013. *Things Come Apart*. London: Thames & Hudson.
- Ordóñez, Lisa D. 1998. “The Effect of Correlation between Price and Quality on Consumer Choice.” *Organizational Behavior and Human Decision Processes* (Elsevier Inc) 75 (3): 258-273. Accessed January 6, 2021.
- Ortega, Damian. 2002. *Cosmic Thing*.
- Peterson, Christine. 2018. How I coined the term ‘open source’. February 1. Accessed January 13, 2021. <https://www.opensource.com/article/18/2/coining-term-open-source-software>.

- Repair Cafe. 2020. About Repair Cafe. Accessed January 13, 2021. <https://www.repaircafe.org/en/about/>.
- Scheffler, Nathanael. 2020. Let's Make Good Stuff. December 10. Accessed December 10, 2020. <https://letsmakegoodstuff.com/>.
- Sennett, Richard. 2009. *The Craftsman*. London: Penguin Books.
- Slade, Giles. 2006. *Made to Break: Technology and Obsolescence in America*. Cambridge: Harvard University Press.
- Sommerville, Sean. 1997. "He's still a company man Founder's son: Alonzo G. Decker Jr., son of one of the founders of Black & Decker, helped spark the do-it-yourself movement. As he approaches his 89th birthday, he maintains his connection to the family business." *The Baltimore Sun*. January 5. Accessed January 13, 2021. <https://www.baltimoresun.com/news/bs-xpm-1997-01-05-1997005004-story.html>.
- Stumpf, Walter. 1927. Electric Tool. US Patent 1633389. June 21.
- Stumpf, Walter. 1928. Rivet Spinning Attachment. US Patent 1689460. October 30.
- The Ellen MacArthur Foundation. 2017. Mission and Vision. Accessed November 16, 2020. <https://www.ellenmacarthurfoundation.org/our-story/mission>.
- . 2019. The Circular Economy in Detail. Accessed December 22, 2019. <https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail>.
- The Repair Association. 2021. Working Together to Make Repair-Friendly Public Policy. January 1. Accessed January 13, 2021. <https://www.repair.org/legislation>.
- Thwaites, Thomas. 2011. *Toaster Project*. New York: Princeton Architectural Press.
- Toronto Tool Library. 2012. About Us. Accessed September 20, 2020. <https://www.torontotoollibrary.com/about-us>.
- Ulric, Karl T, and Scott Pearson. 1998. "Assessing the Importance of Design Through Product Archaeology." *Management Science* 352-369.
- Wikipedia. 2021. Electric Drill. January 5. Accessed January 15, 2021. https://en.wikipedia.org/wiki/Electric_drill.

- . 2020. Metal Injection Molding. December 23. Accessed February 11, 2021. https://en.wikipedia.org/wiki/Metal_injection_molding.
- . 2021. Planned Obsolescence. February 10. Accessed February 11, 2021. https://en.wikipedia.org/wiki/Planned_obsolescence.
- Wilhide, Glenn C. 1946. Electric Screw Driver and Nut Runner. US Patent 2394348. February 5.
- Wilhide, Glenn C. 1949. Switch Assembly for Portable Electric Tools. US Patent 2487011. November 1.
- YouTube. 2021. About YouTube. Accessed January 14, 2021. <https://www.youtube.com/about/>.

APPENDIX

S. D. BLACK & A. G. DECKER,
 DRILL GEARING.
 APPLICATION FILED MAR. 23, 1916.

Patented June 12, 1917.
 3 SHEETS—SHEET 1.

1,229,401.

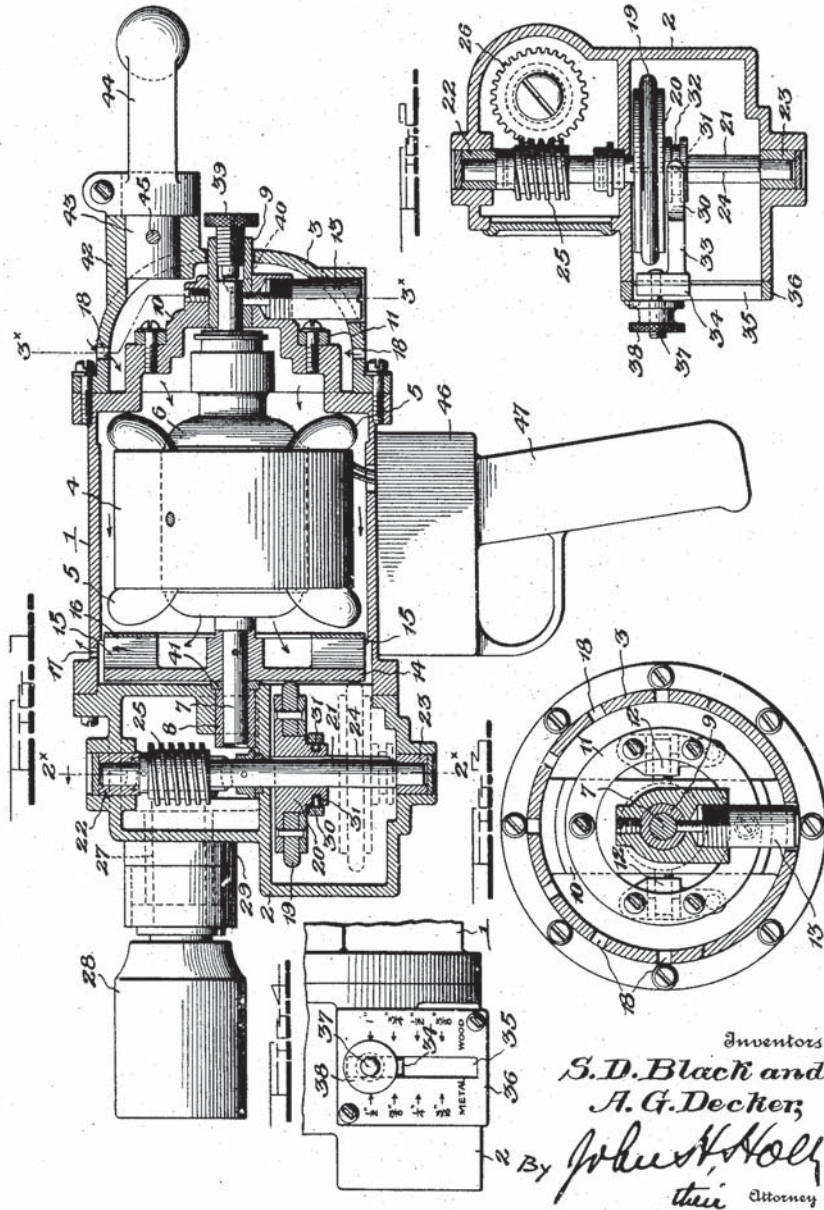


fig. 6.01
 US Patent 1229401
 source: <https://patents.google.com/patent/US1229401>

A SELECTION OF BLACK & DECKER PATENTS

S. D. BLACK & A. G. DECKER.
ELECTRICALLY DRIVEN TOOL.
APPLICATION FILED DEC. 4, 1914.

1,245,860.

Patented Nov. 6, 1917.

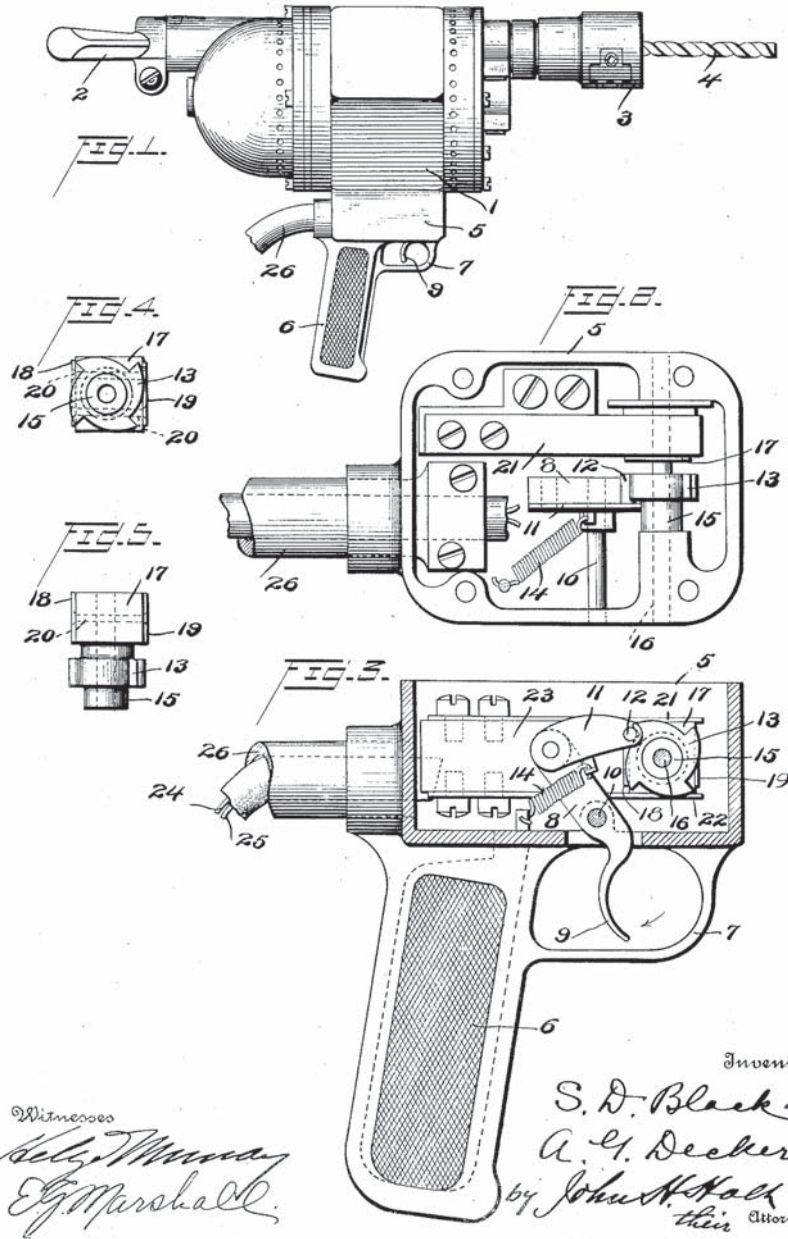


fig. 6.02

US Patent 1245860

source: <https://patents.google.com/patent/US1245860>

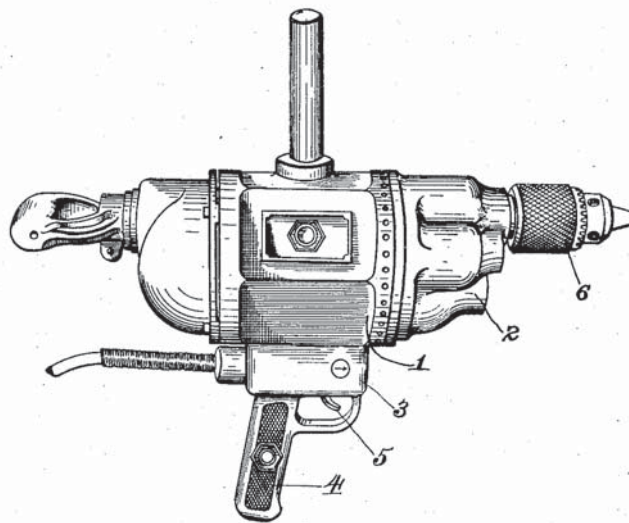
APPENDIX

DESIGN.

S. D. BLACK AND A. G. DECKER.
PORTABLE ELECTRIC TOOL.
APPLICATION FILED MAY 17, 1920.

57,576.

Patented Apr. 26, 1921.



Inventors.
Samuel Duncan Black
and
Alonso G. Decker
by *Edmund Hamble*
Attorney

fig. 6.03

US Patent D57576

source: <https://patents.google.com/patent/USD57576>

A SELECTION OF BLACK & DECKER PATENTS

April 29, 1924.

1,492,095

S. D. BLACK ET AL
ELECTRICALLY DRIVEN TOOL

Filed June 14, 1920

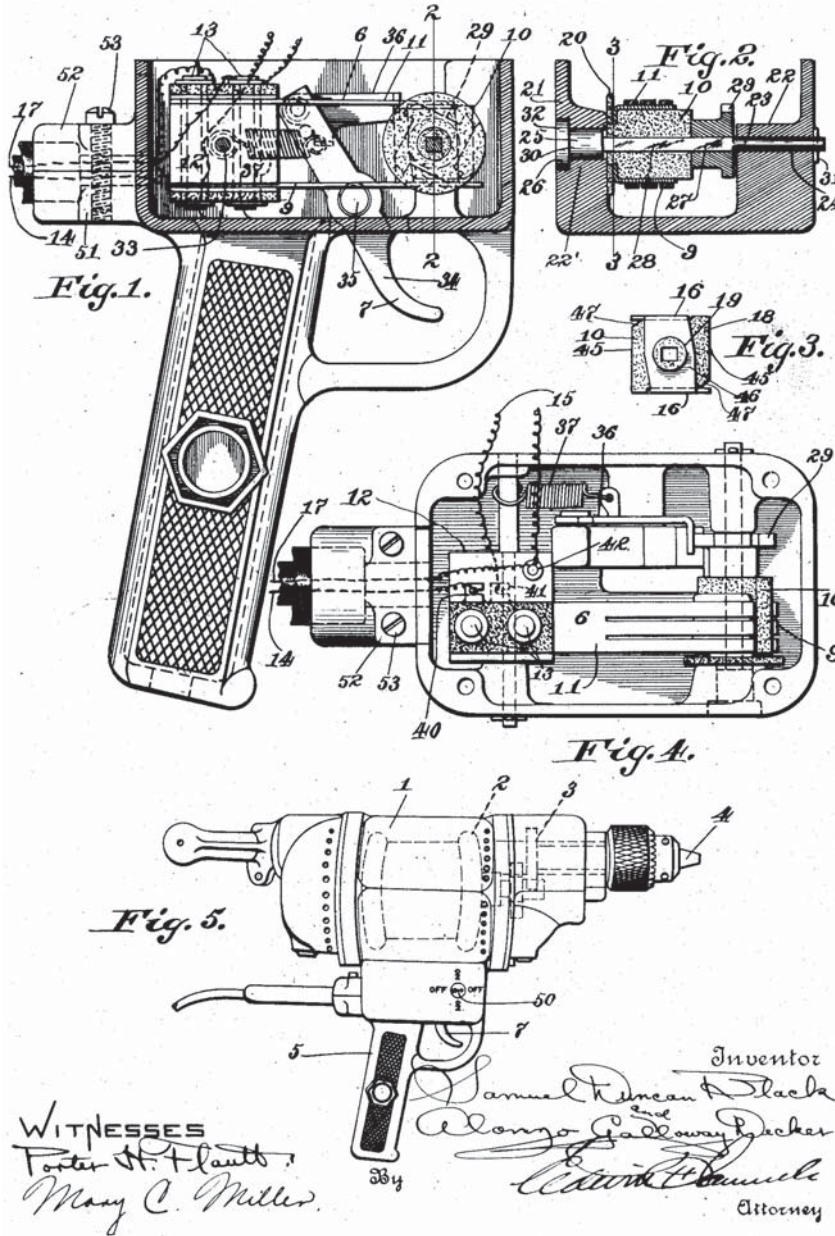


fig. 6.04
US Patent 1492095
source: <https://patents.google.com/patent/US1492095>

APPENDIX

Aug. 4, 1925.

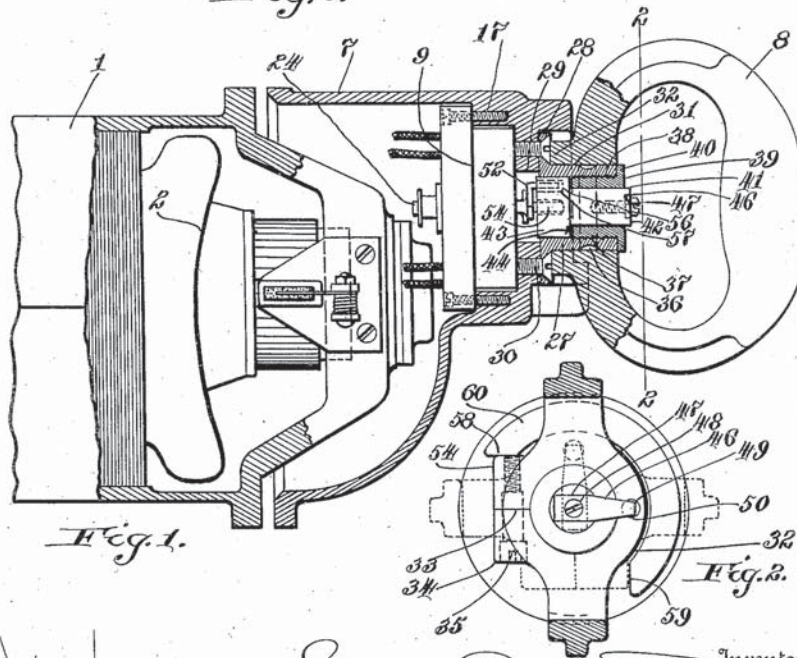
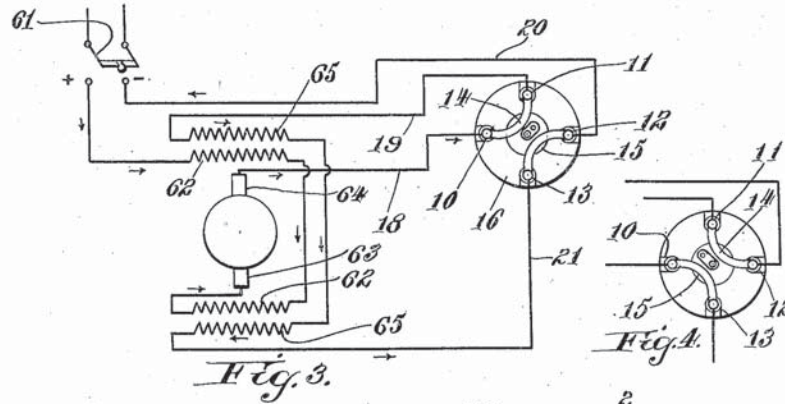
1,548,020

S. D. BLACK ET AL

REVERSING MEANS FOR ELECTRIC TOOLS

Filed March 14, 1924

3 Sheets-Sheet 1



WITNESSES
 Robert H. Faulstich
 E. Nehmeyer

Inventor
 Samuel Duncan Black
 and
 Alonzo Galloway Becker.
 By
 Edmund Hamels
 Attorney

fig. 6.05

US Patent 1548020

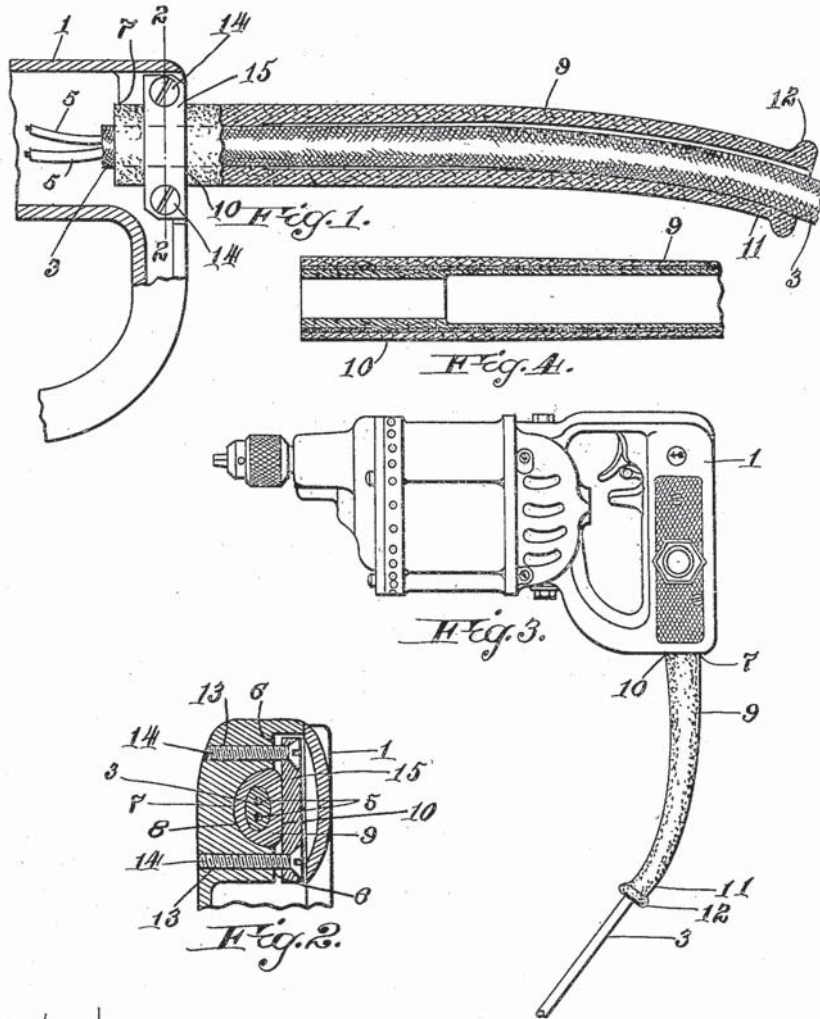
source: <https://patents.google.com/patent/US1548020>

A SELECTION OF BLACK & DECKER PATENTS

Feb. 23, 1926.

1,574,020

S. D. BLACK ET AL
ELECTRIC CORD PROTECTOR
Filed May 19, 1923



WITNESSES
[Signatures]

Inventor
Samuel Duncan Black
and
Alonzo Galloway Decker
[Signature]
Attorney

fig. 6.06
US Patent 1574020
source: <https://patents.google.com/patent/US1574020>

APPENDIX

June 21, 1927.

W. STUMPF

1,633,389

ELECTRIC TOOL

Filed March 15, 1926

2 Sheets-Sheet 1

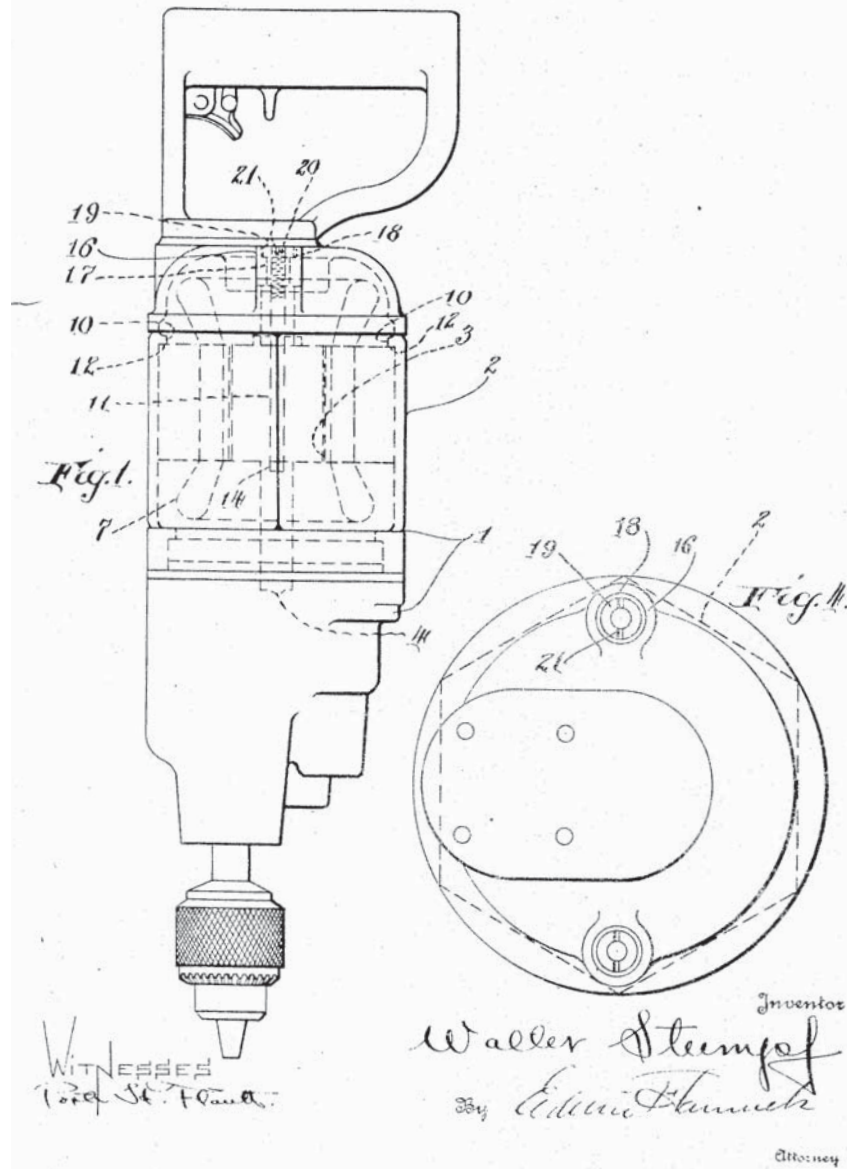


fig. 6.07

US Patent 1633389

source: <https://patents.google.com/patent/US1633389>

A SELECTION OF BLACK & DECKER PATENTS

Nov. 1, 1927.

1,647,396

A. G. DECKER
ROTARY TOOL WITH KEY POCKET

Filed June 25, 1925

3 Sheets-Sheet 1

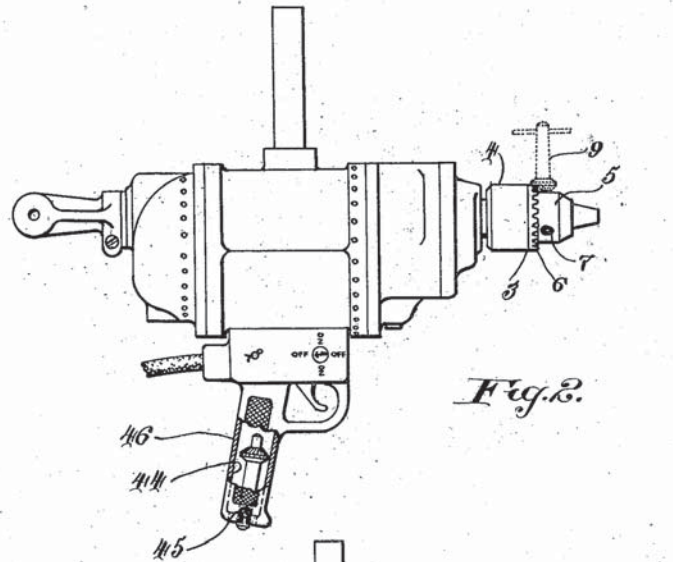


Fig. 2.

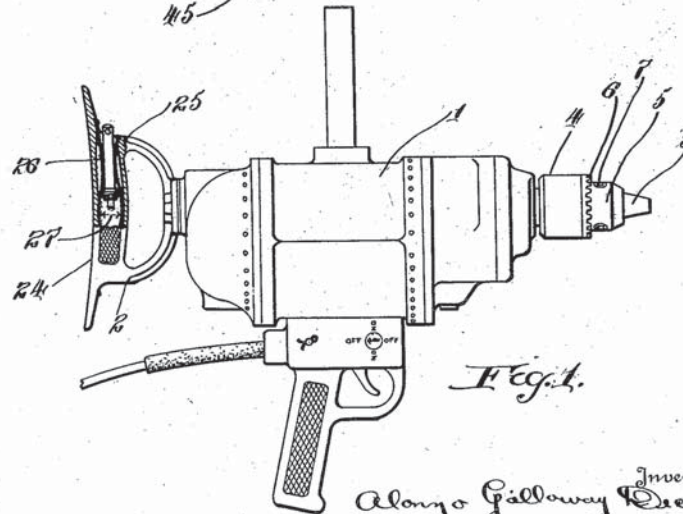


Fig. 1.

WITNESSES
Porter W. F. ...
E. Wehmeier

Alonso Galloway Decker Inventor
E. Wehmeier Attorney

fig. 6.08

US Patent 167396

source: <https://patents.google.com/patent/US1647396>

APPENDIX

Nov. 15, 1927.

1,649,060

A. G. DECKER
 PORTABLE, POWER DRIVEN, ROTARY TOOL WITH SPINDLE
 LATCH AND HAND OPERATED CHUCK
 Filed Oct. 31, 1925

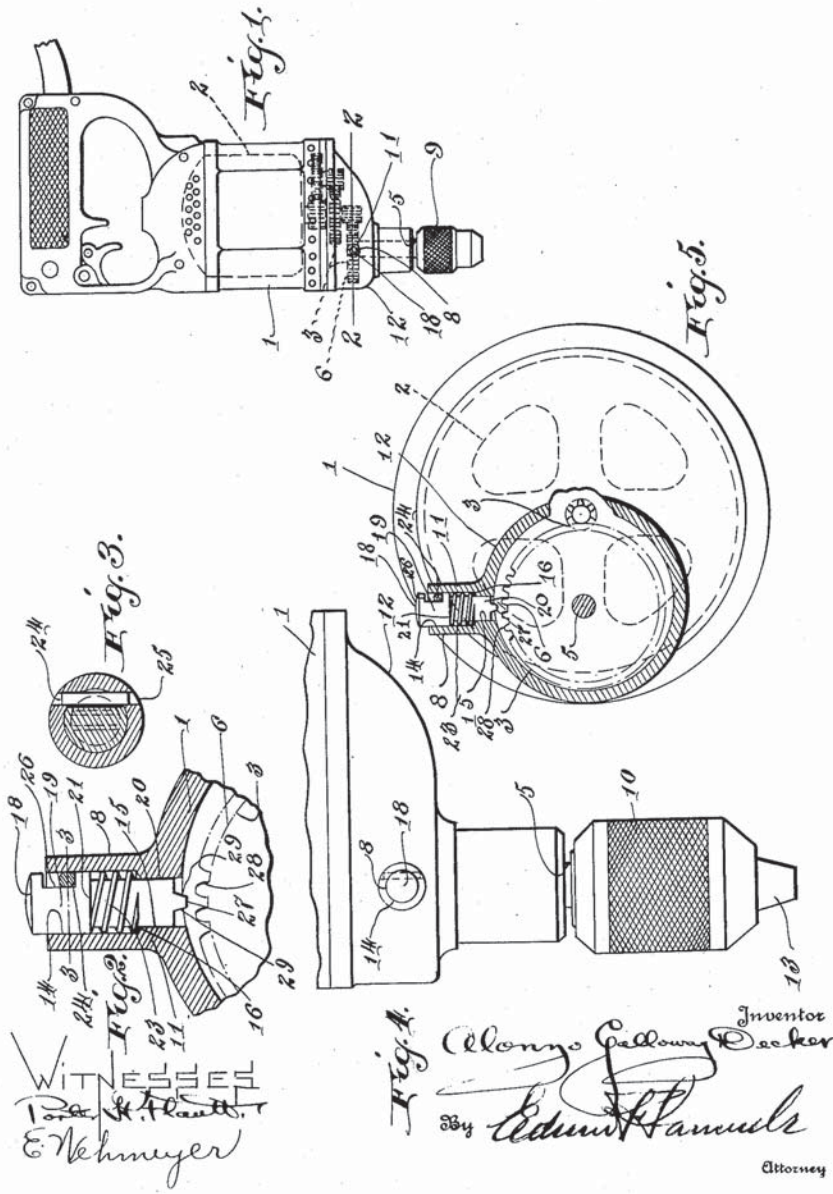


fig. 6.09

US Patent 1649060

source: <https://patents.google.com/patent/US1649060>

A SELECTION OF BLACK & DECKER PATENTS

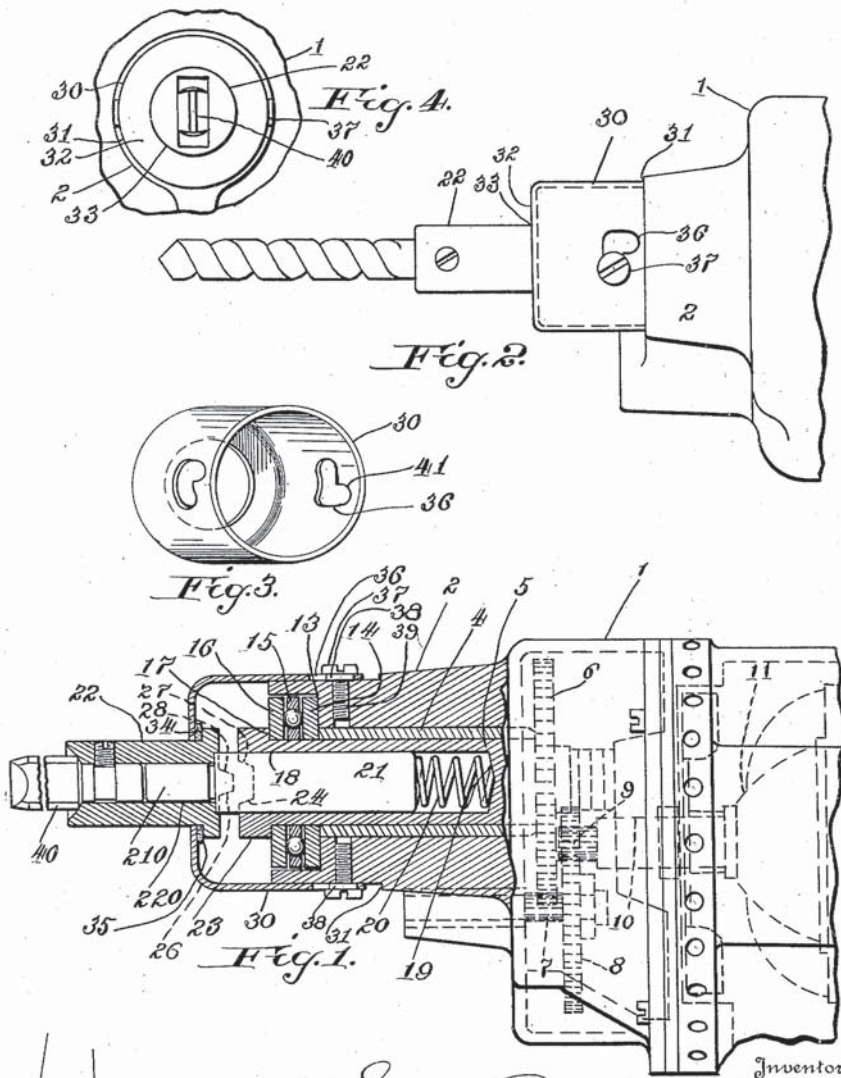
Jan. 22, 1929,

S. D. BLACK ET AL

1,699,870

PORTABLE TOOL

Filed Sept. 26, 1923



WITNESSES
 Frank A. Smith
 Emma Nehmeyer

Inventor
 Samuel Duncan Black
 and
 Alonzo Galloway Decker.
 By *Edward J. Samuel*
 Attorney

fig. 6.10
 US Patent 1699870
 source: <https://patents.google.com/patent/US1699870>

APPENDIX

Feb. 19, 1929.

S. D. BLACK ET AL

1,702,245

ELECTRICAL CONNECTION FOR PORTABLE ELECTRIC TOOLS

Filed Dec. 1, 1923

2 Sheets-Sheet 1

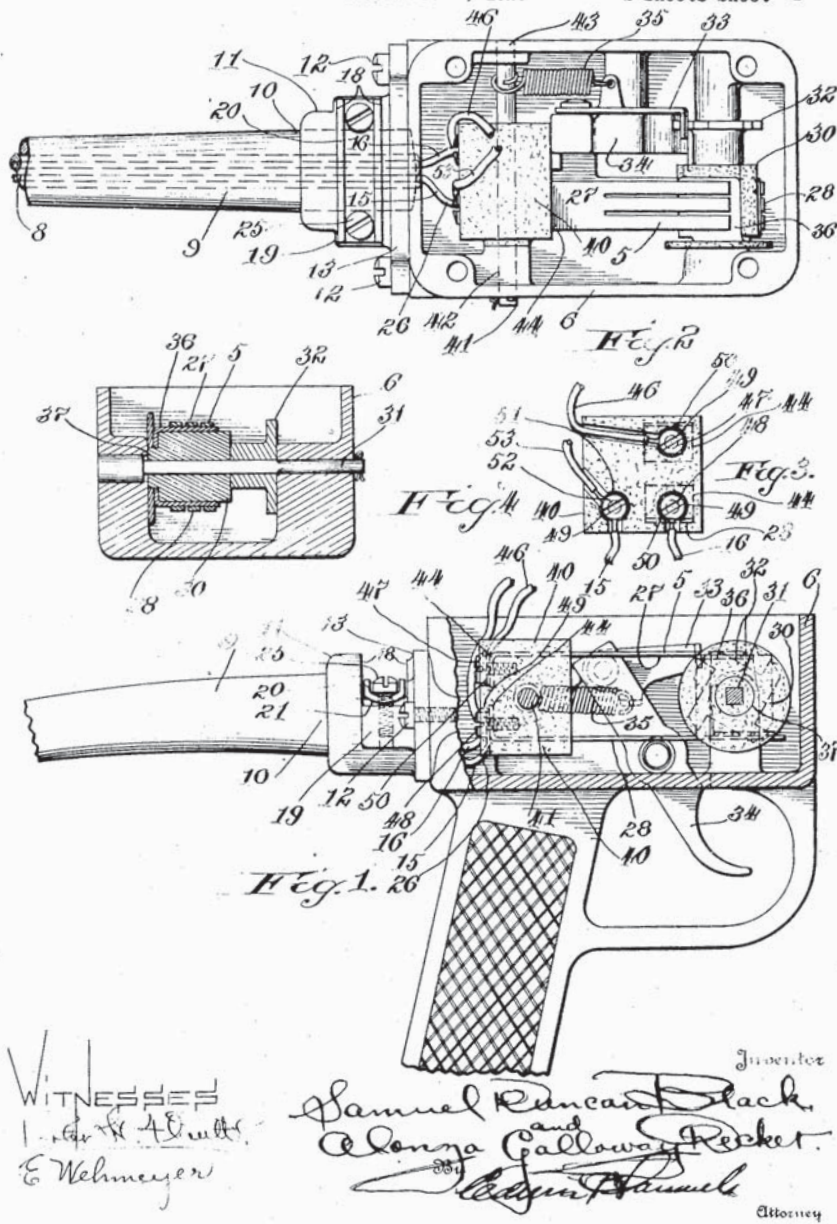


fig. 6.11

US Patent 1702245

source: <https://patents.google.com/patent/US1702245>

A SELECTION OF BLACK & DECKER PATENTS

April 21, 1936.

A. G. DECKER

2,038,422

BENCH DRILL, STAND

Filed Oct. 31, 1933

2 Sheets-Sheet 1

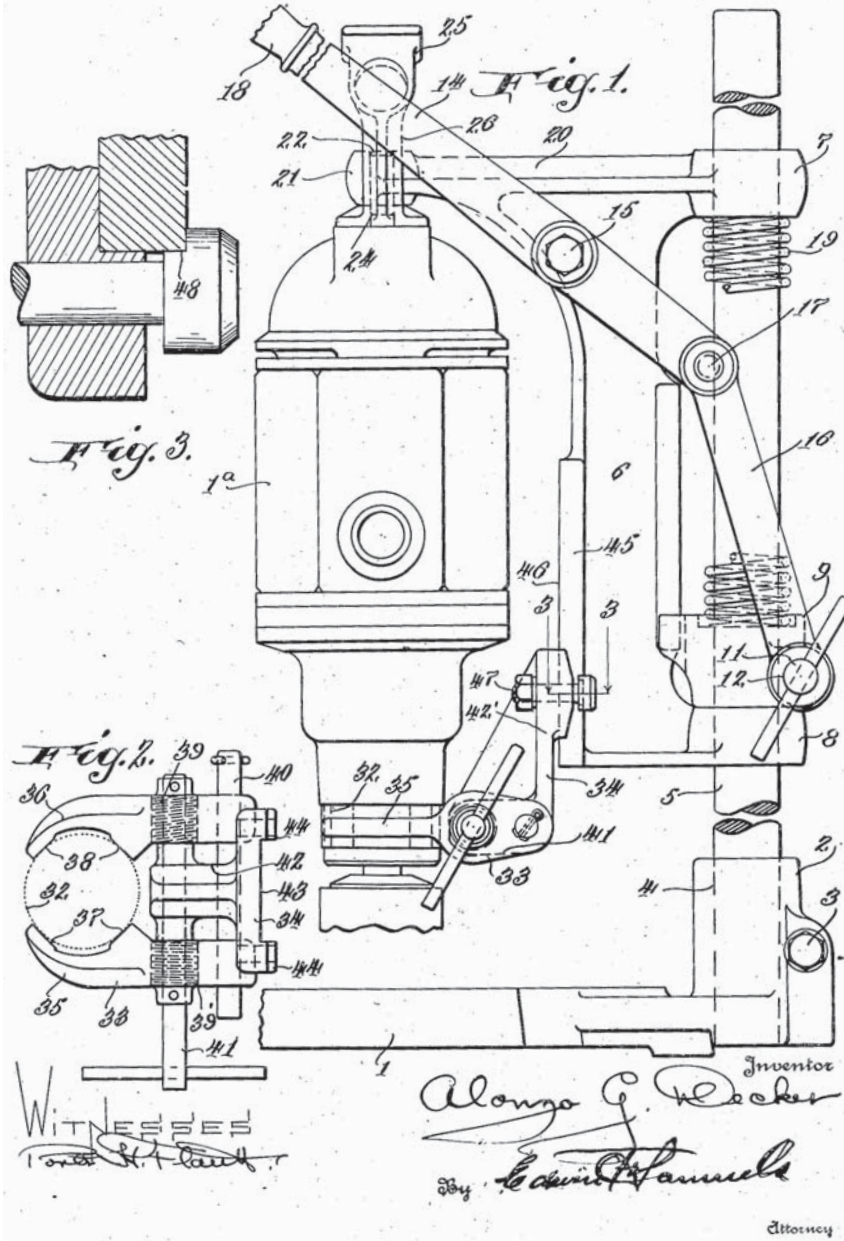


fig. 6.12

US Patent 2038422

source: <https://patents.google.com/patent/US2038422>

APPENDIX

Feb. 5, 1946.

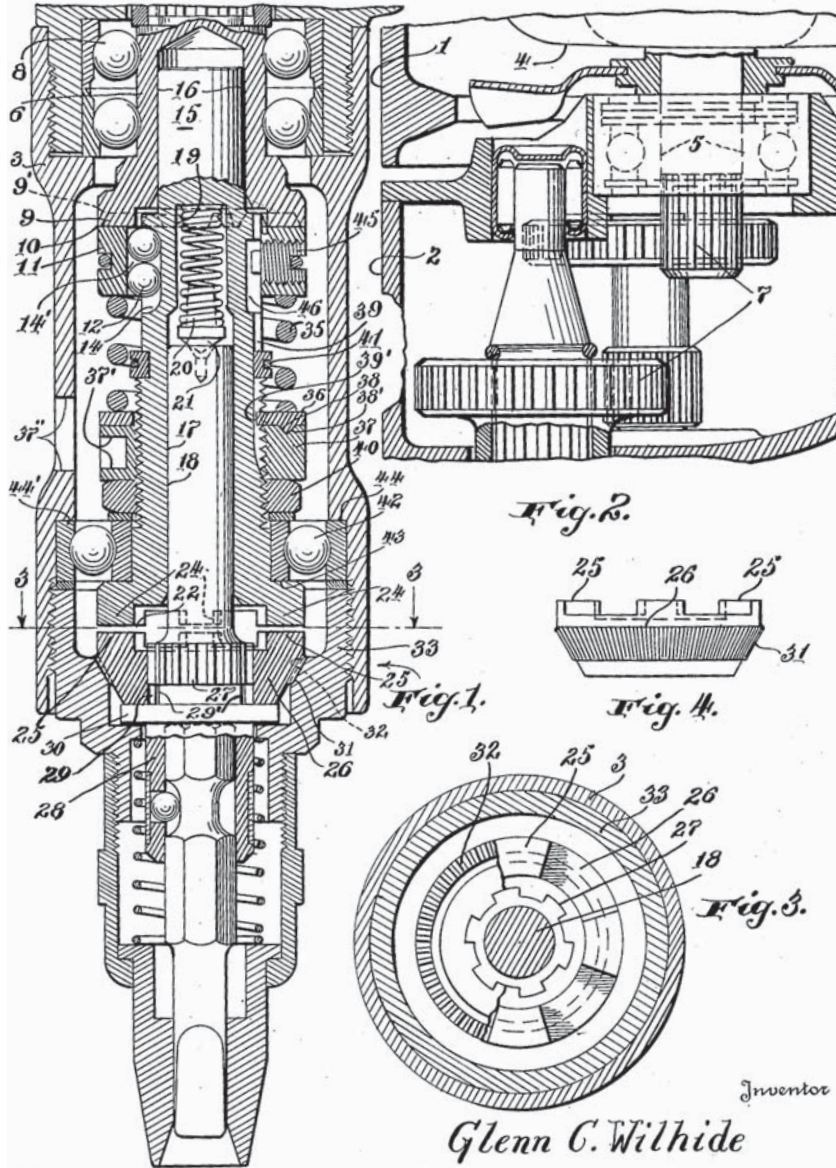
G. C. WILHIDE

2,394,348

ELECTRIC SCREW DRIVER AND NUT RUNNER

Filed July 11, 1940

6 Sheets-Sheet 1



Witness
Robert H. Clark

Inventor
Glenn C. Wilhide
 By *Edward T. Samuels*
 Attorney

fig. 6.13

US Patent 2394348

source: <https://patents.google.com/patent/US2394348>

A SELECTION OF BLACK & DECKER PATENTS

Nov. 1, 1949

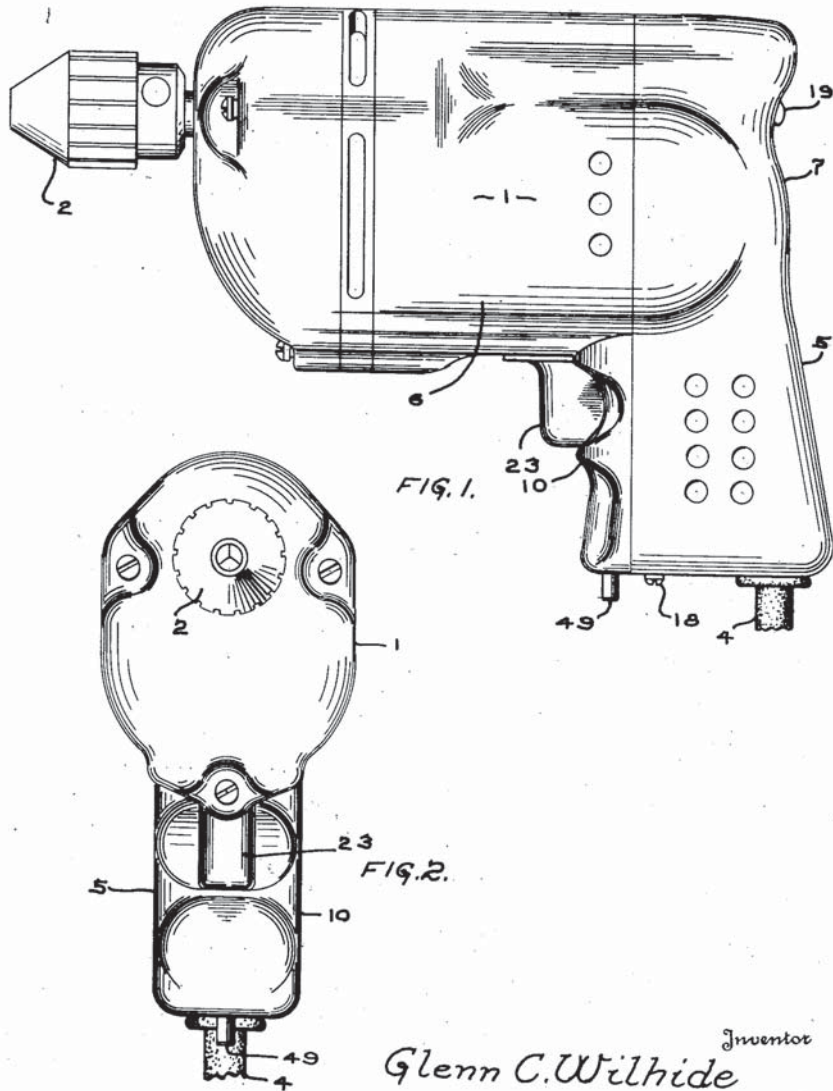
G. C. WILHIDE

2,487,011

SWITCH ASSEMBLY FOR PORTABLE ELECTRIC TOOLS

Filed June 18, 1946

4 Sheets-Sheet 1



Witness
Forster R. F. Lauth

Inventor
Glenn C. Wilhide
By Thomas W. Clark
Attorney

fig. 6.14
US Patent 2487011
source: <https://patents.google.com/patent/US2487011>

APPENDIX



fig. 6.15

1924 Black & Decker Ad

source: <https://www.atticpaper.com/proddetail.php?prod=1924-black-decker-electric-drill-ad>

A SELECTION OF BLACK & DECKER ADS

"The Pistol Grip and Trigger Switch"
-its part in Modern Industry-



... Fifteen years ago two partners started a jobbing machine shop.

Being practically unknown, the only work they could get at first was that which other machine shops turned away as extra hazardous.

This developed latent ability and daring in a way that nothing else could, resulting in an organization of precision specialists. They made adding machines, currency presses for the Government, milk bottle cap machines, motion picture projectors, postage stamp machines, firing mechanisms for guns, duplicators, gunights—a class of work requiring accuracy to the finest degree.

After several years, however, they decided to produce some commercial items which could be manufactured by them in between big jobs, providing a means for keeping their unusual organization intact.

Their own experience influenced them to undertake the manufacture of Portable Electric Drills, because they had found them among the most necessary tools in their own shop.

They analyzed the crude electric drills then being used, and determined to make Black & Decker Portable Electric Drills more powerful, lighter in weight, longer lived, and more easily controlled.

The most perfect control ever devised by man for operating a mechanical device is the "trigger". From the time of the first cross bow to the present-day automatic pistol, the control of the index finger on a trigger has trampled over other methods.

It was quite natural to carry this idea out and this was the origin of

"The Pistol Grip and Trigger Switch"

This method of control for electric tools originated with Black & Decker and the genuine "Pistol Grip and Trigger Switch" is found only on Black & Decker Tools.

Mechanics who use Electric Drills can readily distinguish the genuine Black & Decker by the "Pistol Grip and Trigger Switch". Other radical improvements followed, of which we hope to tell more later.

The little machine shop disappeared long ago and a large factory grew in its place; then a larger plant in the country, which, even as this is written, is being further enlarged.

Black & Decker Portable Electric Drills, Electric Screw Drivers, Electric Sucker Wrenches and Electric Grinders may be obtained from the leading mill supply, machinery, automotive and electrical supply houses.

The BLACK & DECKER MFG. CO.
 TOWSON, MARYLAND, U.S.A.
 Canadian Factory—Lynn Tobe Bldg., Montreal, P. Q.



BLACK & DECKER
With the Pistol Grip and Trigger Switch

Portable Electric Drill

fig. 6.16

1925 Black & Decker Ad

source: <https://www.atticpaper.com/proddetail.php?prod=1925-black-decker-electric-drill-ad>

APPENDIX

HELPING GOOD MECHANICS DO BETTER WORK

1/2-INCH HEAVY DUTY DRILL

All over the world, wherever there are holes to be drilled, good tool buyers demand Black & Decker products. You can do a better job and improve the quality of your craftsmanship by using one or more of the 200 different tools in the Black & Decker line. Sold and serviced through leading distributors everywhere. The Black & Decker Mfg. Co., Dept. P, Towson, Md.

Black & Decker
World's Largest Manufacturer of **BLACK & DECKER**
PORTABLE ELECTRIC TOOLS

fig. 6.17

1937 Black & Decker Ad


source: <https://www.amazon.ca/1937-Black-Decker-Heavy-Drill/dp/B00GIO368K>

A SELECTION OF BLACK & DECKER ADS


In the house, workshop or field-

**the B&D Utility
1/2" Drill is like an
extra hand!**


Only \$44.95




Drill holes for new electrical outlets, home repairs and improvements.




Drill out rusty bolts, bore new holes, etc., when repairing tools and machinery.



Use it to build and repair fences, maintain exterior buildings, etc.



BENCH STAND for B&D Utility 1/2" Drill provides smooth, steady drill press operation. Only \$22.95



For all-purpose drilling in all kinds of materials, the Black & Decker Utility 1/2" Drill is your best buy! Makes even the toughest jobs go quickly and smoothly, without the hard work of hand drilling. Use it for maintenance work around the house, repairing tools and implements, building fences, wagons, pens, etc. It drills up to 1/2" holes in steel, drives wood augers up to 1", and Hole Saws up to 3". Like all B&D tools, the B&D Utility 1/2" Drill has a powerful motor, and is top-quality throughout for stamina and long life. Get a demonstration at your nearby hardware, building supply or farm implement dealer. For free 52-page book of job tips, write: THE BLACK & DECKER MFG. Co., Dept. H5J, Towson 4, Maryland.

Black & Decker
ELECTRIC
UTILITY TOOLS
PORTABLE
ELECTRIC
TOOLS

fig. 6.18

1950's Black & Decker Ad

source: <https://www.bonanza.com/k/black-decker-print-ad-1950s-/1019591>

APPENDIX

ELECTRIC HOME-UTILITY TOOLS

Some of the many uses of Home-Utility Tools in the Home, on the Farm or in the Workshop:



REMOVING PAINT



POLISHING CAR



SAWING WOOD



DRILLING METAL



SHARPENING CUTLERY



REMOVING RUST

FOR HOMES, HOBBY SHOPS, FARMS

Form #550Litho. in U.S.A.

fig. 6.19

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

A SELECTION OF BLACK & DECKER ADS

ELECTRIC
HOME-UTILITY
TOOLS

GREAT VERSATILITY AT A POPULAR PRICE

for HOMES, FARMS,
HOBBY SHOPS,
TOOL KITS

PRODUCT OF THE BLACK & DECKER MFG. CO.

fig. 6.20

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

APPENDIX

ELECTRIC HOME-UTILITY TOOLS

1/2 INCH-PORTABLE ELECTRIC DRILL



\$35.95

Catalog No. HU-20

1/2" CAPACITY IN STEEL
WEIGHS 9 1/2 LBS.
15 5/8" LONG

Useful
FEATURES!

- 1 Aluminum housings reduce weight, stand hard use.
- 2 Instant-release trigger switch . . . 3-wire electric cord.
- 3 "Universal" motor runs on 115-volts, A.C. or D.C.
- 4 Jacobs hex-key chuck operates fast, holds tight.
- 5 Spade handle and removable pipe handle.

For general "all-purpose" drilling—in all kinds of materials—the Home-Utility 1/2" Drill is your practical buy. It drills from 1/8" to 1/2" in steel, drives wood augers up to 7/8", hole saws up to 2 1/2". *On the Farm*, it has "extra" capacity for drilling larger holes in machinery, rigging, construction and repair work. *In the Hobby Shop*, it makes a handy drill press in the Bench Stand. *Out on the Job*, it handles many installation, maintenance and repair jobs.

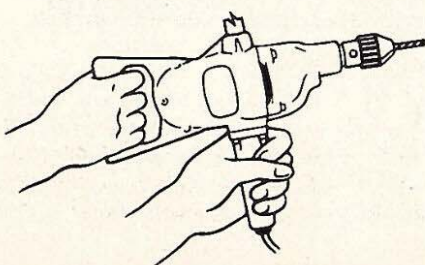



fig. 6.21

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

A SELECTION OF BLACK & DECKER ADS

ELECTRIC HOME-UTILITY TOOLS

HORIZONTAL STAND

FOR 1/4" DRILL AND 5" SANDER-POLISHER



\$3.35

Catalog No.
HU-2302

To permit the Home-Utility 1/4" Drill or 5" Sander-Polisher to be clamped horizontally on a bench this stand is provided. Both hands are free to apply work in using grinding wheels, buffing wheels, wire wheel brushes and many abrasive accessories. Also required for using Disc Sanding Table Attachment.

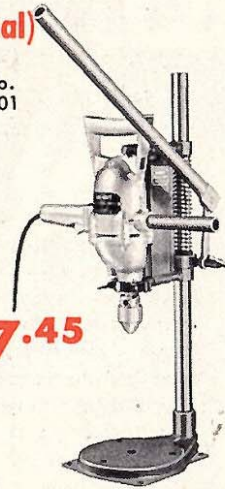
BENCH STANDS (Vertical)

Cat. No.
HU-2300



\$11.45

Cat. No.
HU-2301



\$17.45

1/4" Bench Stand for 1/4" Portable Electric Drill and 5" Sander-Polisher 1/2" Bench Stand for 1/2" Portable Electric Drill

The Home-Utility 1/4" and 1/2" Bench Stands are time-saving, work-improving additions to your equipment. Tools fit into their stands in a few seconds . . . and are removed just as quickly. Frees one hand to guide work and lubricate drilling.

fig. 6.22

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>


APPENDIX

ELECTRIC
HOME-UTILITY
TOOLS

5-INCH SANDER- POLISHER

\$29.95

Cat. No. HU-50
6 5/8" LONG
WEIGHS 3 1/2 LBS.
(with sanding disc attached)



OUTSTANDING FEATURES!

- 1 Strong light die-cast alum. housing 115-volt "Universal" motor.
- 2 Instant-release trigger switch—can be locked "ON" if desired.
- 3 10 feet of 3-conductor cable—third wire for grounding.
- 4 Balanced design with comfortable handling for one or two-handed use.
- 5 Complete standard equipment includes rubber backing pad, 3 sanding discs, lambswool bonnet and can of Electric Wax.

Surprisingly versatile, the Home-Utility 5" Sander-Polisher offers quick results in sanding and polishing all types of surfaces. Standard equipment includes a rubber backing pad, 3 sanding discs, lambswool bonnet and can of Electric Wax. With additional accessories (shown on the following pages) this tool will also drill, grind, clean, buff and burnish—performing these operations in a great variety of home, hobby-shop and farm jobs. "All-around" usefulness is the chief characteristic of this new tool. High quality motor gives ample power margin.

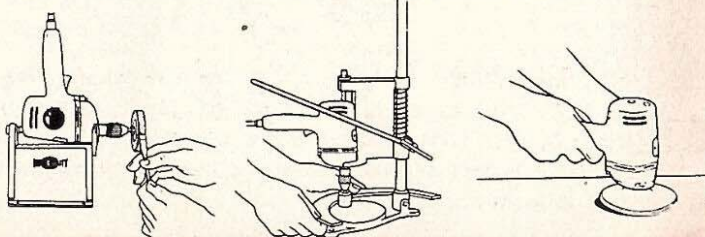


fig. 6.23

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

A SELECTION OF BLACK & DECKER ADS

ELECTRIC HOME-UTILITY TOOLS

SANDING AND POLISHING ACCESSORIES FOR 1/4" ELECTRIC DRILL AND 5" SANDER-POLISHER

MOULDED RUBBER PAD

This Backing Pad for Sanding Discs, Lambswool Bonnets or Pile Fabric Pads is now available with either a 1/4" chuck spud or a threaded shank which screws directly into tool spindle.

CAT. No. HU-1302 5" Moulded Rubber Pad with spud for 1/4" Chuck **\$1.75**

Cat. No. HU-1300 5" Moulded Rubber Pad with threaded shank **\$1.75**



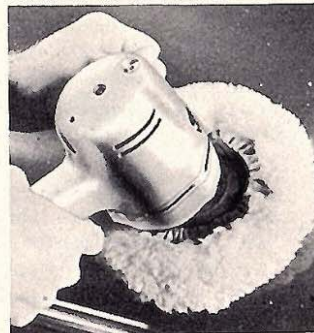
5" SANDING DISCS

Package of 6—5" 50-grit (coarse) Open Grain Sand Discs — CAT. No. HU-1410..... **\$.60**

Package of 6—5" 80-grit (medium) Open Grain Sand Discs — CAT. No. HU-1411..... **\$.50**

Package of 6—5" 120-grit (fine) Open Grain Sand Discs — CAT. No. HU-1412..... **\$.45**

SAND ANY SURFACE



5" LAMBSWOOL BONNET

For polishing and waxing at high speed **\$1.25**

POLISH ANY SURFACE

3" WIRE CUP BRUSH

CAT. No. HU-1220

Has threaded hub—screws directly into tool spindle. For cleaning, burnishing and removal of rust and old paint..... **\$2.40**

5" PILE FABRIC PAD

CAT. No. HU-1301

For rubbing down "orange peel" and spray pits from new lacquer giving a smooth, uniform surface **\$1.25**



**RUBBER
PAD AND BONNET**

fig. 6.24

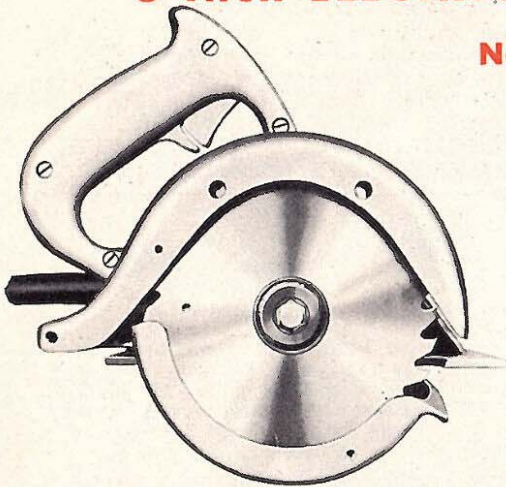
1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

APPENDIX

ELECTRIC **HOME-UTILITY** **TOOLS**

6-inch ELECTRIC SAW



New Low Price
\$54.50
Cat. No. HU-60

Designed for a variety of essential uses in general carpentry, home construction or alteration and many maintenance jobs on the farm.

Diameter of Saw Blade 6-1/8"
Depth of Cut 2-1/16"—Weighs 9-1/2 lbs.

QUALITY FEATURES

1. Trigger switch (2-pole) turns saw "off" instantly when trigger is released.
2. Aluminum housing give light weight and a compact, comfortable shape that saves time and effort in carpentry.
3. "Universal motor runs on 115-volts A.C./D.C.
4. A telescoping lower blade slides open and springs closed automatically for complete safety.
5. Saw dust is blown clear of the guide line in front of the saw.

The new Home-Utility universal motor is built by Black and Decker specifically for power sawing and provides more than adequate power for a normal 2" depth-of-cut. Along with superior balance and handling ease, many quality features are built into this new tool which give it durability and stamina well above the usual low priced power saw.

fig. 6.25

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

A SELECTION OF BLACK & DECKER ADS



SAW BLADES for 6 Inch SAWS

<p>6 1/8-inch COMBINATION BLADE Catalog No. HU-1600</p> <p>A fast-cutting blade for ripping in all kinds of wood and general cross-cutting. Supplied as standard equipment with the Home-Utility 6-inch Saw. Price, each.....</p>	 COMBINATION \$3.25
<p>6 1/8-inch CROSSCUT BLADE Catalog No. HU-1602</p> <p>For fast, smooth cross-cutting. Makes a smoother cut than the Combination Blade. Price, each</p>	 CROSS CUT \$3.25
<p>6 1/8-inch PLANER BLADE Catalog No. HU-1601</p> <p>For making very smooth cuts, both rip and cross-cut, for interior woodworking. Price, each</p>	 PLANER \$7.75
<p>6-inch ABRASIVE DISC Catalog No. HU-1603</p> <p>For cutting slate, marble, asbestos, tile, transite and porcelain. Price, each.....</p>	 ABRASIVE \$3.00
<p>6 1/8-inch NAIL CUTTING BLADE Catalog No. HU-1604</p> <p>An especially useful blade in shipping and receiving departments and for building repair work. Rips out old flooring or cuts floor packets without nail damage to saw blade teeth. Use wherever nails are to be encountered. Price, each</p>	 NAIL CUTTING \$4.25



DEPTH AND BEVEL ATTACHMENT

This one accessory enables the Home-Utility 6" Saw to:

1. CUT TO ANY SPECIFIED DEPTH FROM 0" to 1-15/16".
2. MAKE ANY BEVEL CUT FROM 45° to 90°
3. BEVEL CUT WITH THE DEPTH-OF-CUT REGULATED AT THE SAME TIME

The attachment is of steel and is assembled directly to the complete 6" Saw with two bolts and a machine screw. Once assembled there is no further need for removal as normal Saw operation is not impaired by this attachment—in fact the larger shoe area often proves convenient.

Both BEVEL and DEPTH-OF-CUT adjustments are controlled by two large wing nuts.

Depth-of-cut range: Attachment at 90°, 0" to 1-15/16".
Attachment at 45° 0" to 1 3/8".

Cat. No. HU-1611. **NEW LOW PRICE \$5.45**

fig. 6.26

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

APPENDIX

ELECTRIC
HOME-UTILITY
TOOLS



**RIP FENCE
FOR 6-inch SAW**

Maximum width of cut .. $7\frac{3}{8}$ "
Minimum width of cut... $1\frac{1}{4}$ "

\$3.00

Cat. No. HU-1612

Holds the saw blade at a predetermined distance from edge of board in rip cutting. Also adapted to the multiple cross-cutting of short pieces. Attaches directly to existing holes in the Depth and Bevel Attachment shown on preceding page—only one bolt to tighten. Eliminates a great deal of lost time in scribing guide lines. Operates perfectly whether cutting at 90° or at bevel angles from 45° to 90° .

SAW CARRYING CASE



Protect your 6" Saw in good or bad weather with this fitted, steel Carrying Case. Has plenty of additional room for extra saw blades, Rip Fence and extra Extension Cable. Also holds Saw in position with or without the Depth and Bevel Attachment assembled to it. Carry complete sawing equipment to the job—carry it in this handy protective case!

Cat. No. HU-1610 **\$6.00**



**18 GAGE
EXTENSION CABLE**

Cat. No. HU-2299 **\$2.95**

This 18 Gage Extension Cable is suitable for all Home-Utility tools except the 6-inch Saw which requires a 16 Gage cable to prevent loss of power. Has third grounding wire to connect to third wire in tool cable and to a ground. Cable is rubber covered and has rubber plug and receptacle.

fig. 6.27

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

A SELECTION OF BLACK & DECKER ADS

ELECTRIC
HOME-UTILITY
TOOLS

SERVICE

For expert "factory" repairs to your Home-Utility tool, send it (or have your dealer send it) to the most convenient of our Factory Service Branches listed below. All of these are equipped with genuine replacement parts, the correct tools and the "know-how" to give you prompt, efficient service.

FACTORY SALES & SERVICE BRANCHES

ATLANTA 3, GEORGIA.....	316 TECHWOOD DRIVE, N.W.
BALTIMORE 11, MARYLAND.....	203 WEST 28th STREET
BOSTON 15, MASSACHUSETTS.....	60 BROOKLINE AVENUE
BUFFALO 8, NEW YORK.....	17 EAST UTICA STREET
CHARLOTTE 6, NORTH CAROLINA.....	117 E. NINTH STREET
CHICAGO 7, ILLINOIS.....	1100 W. JACKSON BLVD.
CINCINNATI 2, OHIO.....	1094 GILBERT AVENUE
CLEVELAND 15, OHIO.....	2118 E. 21st ST. (AT CARNEGIE)
DALLAS 1, TEXAS.....	2613 ROSS AVENUE
DENVER 4, COLORADO.....	1010 BANNOCK STREET
DETROIT 2, MICHIGAN.....	3028 EAST GRAND BOULEVARD
HOUSTON 3, TEXAS.....	409 VELASCO STREET
INDIANAPOLIS 2, INDIANA.....	1125 WEST 16th STREET
KANSAS CITY 8, MISSOURI.....	1603 OAK STREET
LOS ANGELES 7, CALIFORNIA.....	1941 SOUTH FLOWER STREET
MEMPHIS 3, TENNESSEE.....	921 S. THIRD STREET
MINNEAPOLIS 2, MINNESOTA.....	1012 MARQUETTE AVENUE
NEWARK 5, NEW JERSEY.....	611 McCARTER HIGHWAY
NEW ORLEANS 13, LOUISIANA.....	639 DRYADES STREET
NEW YORK 13, NEW YORK.....	55 VANDAM STREET
PHILADELPHIA 30, PENNSYLVANIA.....	710 NORTH 16th STREET
PITTSBURGH 13, PENNSYLVANIA.....	4740 BAUM BOULEVARD
PORTLAND 9, OREGON.....	1640 N.W. JOHNSON ST.
SAN FRANCISCO 3, CALIFORNIA.....	1090 BRYANT STREET (AT 9th)
SEATTLE 9, WASHINGTON.....	434 EIGHTH AVE., N.
ST. LOUIS 3, MISSOURI.....	2822 LOCUST STREET

Products of The BLACK & DECKER Mfg. Co.

fig. 6.28

1950's Black & Decker Brochure

source: <https://www.ebay.ca/itm/Home-Utility-Electric-Tools-Small-Vintage-Brochure-Black-Decker-Mfg-Co/202398284749?hash=item2f1fe0bbcd:g:XKEAAOSwZrdbLkpn>

APPENDIX

MAN gifts!

3 new BLACK & DECKER POWER KITS

ring the bell in a raft of jobs!

Direct way to your handyman's heart this Christmas is a B&D Power Kit—the brand-new kit idea that mates a versatile power unit with your choice of the three attachments men want most—in a sparkling gift case!

There's massive power in the famous B&D U-3 1/4" Drill featured in each kit. There's man-size satisfaction in the jobs he'll be able to do—right away—with any of these high-quality B&D attachments that are engineered for the tool. And there's man-size value your B&D dealer has waiting for you—which ever Kit you choose! The Black & Decker Mfg. Co., Dept. L-127, Emerson 4, Md. (In Canada: P. O. Box 276, Brockville, Ont.)

Black & Decker gifts are priced to fit your pocketbook! Kits from \$39.95—Tools from \$29.95—Attachments from \$10.45.

Featuring the home power unit with "pro" quality

The famous **U-3 Drill** in three new combinations

For a Little Man Gift? See Andy Gurd's working model of U-3 at your toy store. Look under "Tools-Electric"

Black & Decker
World's Largest Maker of Electric Tools

1 NEW JOG SAW-DRILL POWER KIT joins versatile, new B&D Jog Saw Attachment with B&D U-3 1/4" Drill, the power unit that can drive many other B&D attachments. Makes shelves, valences, bookracks, toys, lawn furniture, wall papers, home repairs.

2 NEW SANDER-DRILL POWER KIT pairs fast-finish Orbital Sanding Attachment with top-quality U-3 1/4" Drill. Refinishes book cases, furniture, even antiques. Prepares stains for refinishing. Customers get professional results.

3 NEW SAW-DRILL POWER KIT combines world's safest Saw Attachment with famous B&D U-3 1/4" Drill. Makes book shelves, furniture, toys. Cuts laminar, plywood, compositions. Built-in depth and level adjustments for easy, accurate work.

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fig. 6.29

Black & Decker Gift Ad

source: <https://www.stanleyblackanddecker.com/who-we-are/our-history/innovation/do-it-yourself-market-america-embraces-self-reliance>

A SELECTION OF BLACK & DECKER ADS



Upper Left: World's First 1/4" Cordless Electric Drill* by Black & Decker—a marvel of modern design and convenience. Completely portable. No cord! No plug! No outlet! Use it anywhere—at home or away.

The amazing Power Pack, inside handle, takes over 400 charges. Simply connect with compact Black & Decker Power Pack Charger. One charge, for example, provided ample power to drill 300 1/8", 200 1/4" or 75 1/2" holes in 3/4" fir. Shockproof. Only 4 pounds. A thrilling gift. C-601. Only \$59.90 complete with Power Pack Charger. *Patents Pending ©1961

Upper Right: Unique New Air-Cooled Deluxe Jig Saw. U-251. Smoothest, coolest plain or fancy cutting. Saddle horn grip. 3000 Cycloid strokes per minute. No splintering. Jig Saws from \$29.95.

Powerful New 3/8" Utility Drill. U-120. More torque for tough jobs. True double reduction gears. Special low price. Drills from \$16.95.

Only 25¢! 180-page book "How to Choose and Use Power Tools." Write: The Black & Decker Mfg. Co., Dept. D-121, Towson 4, Md.

Bottom: Handsome 30-Piece Drill Kit for priceless pleasure on countless jobs. Exceptional quality. New Black & Decker 1/4" Drill with most-wanted accessories for drilling, sanding, grinding, buffing, polishing. U-111 includes Picture Hanger Kit, 5 Drill Bits, Grinding Wheel, 12 Sanding Discs, Wire Wheel Brush—lots more. Smart steel case. Kits from \$26.95.



Black & Decker
WORLD'S LEADING MAKER OF POWER TOOLS
AND THE WORLD'S FIRST CORDLESS ELECTRIC DRILL



Also available in Canada

fig. 6.30

1961 Black & Decker Gift Ad with the World's First Cordless Electric Drill
source: <https://www.ebay.ca/itm/1961-Black-Decker-Power-Tools-1-Man-Christmas-Gift-photo-art-decor-vintage-ad/174107953344?hash=item2889a488c0:g:VMsAAOSwZwld3aFt>

APPENDIX

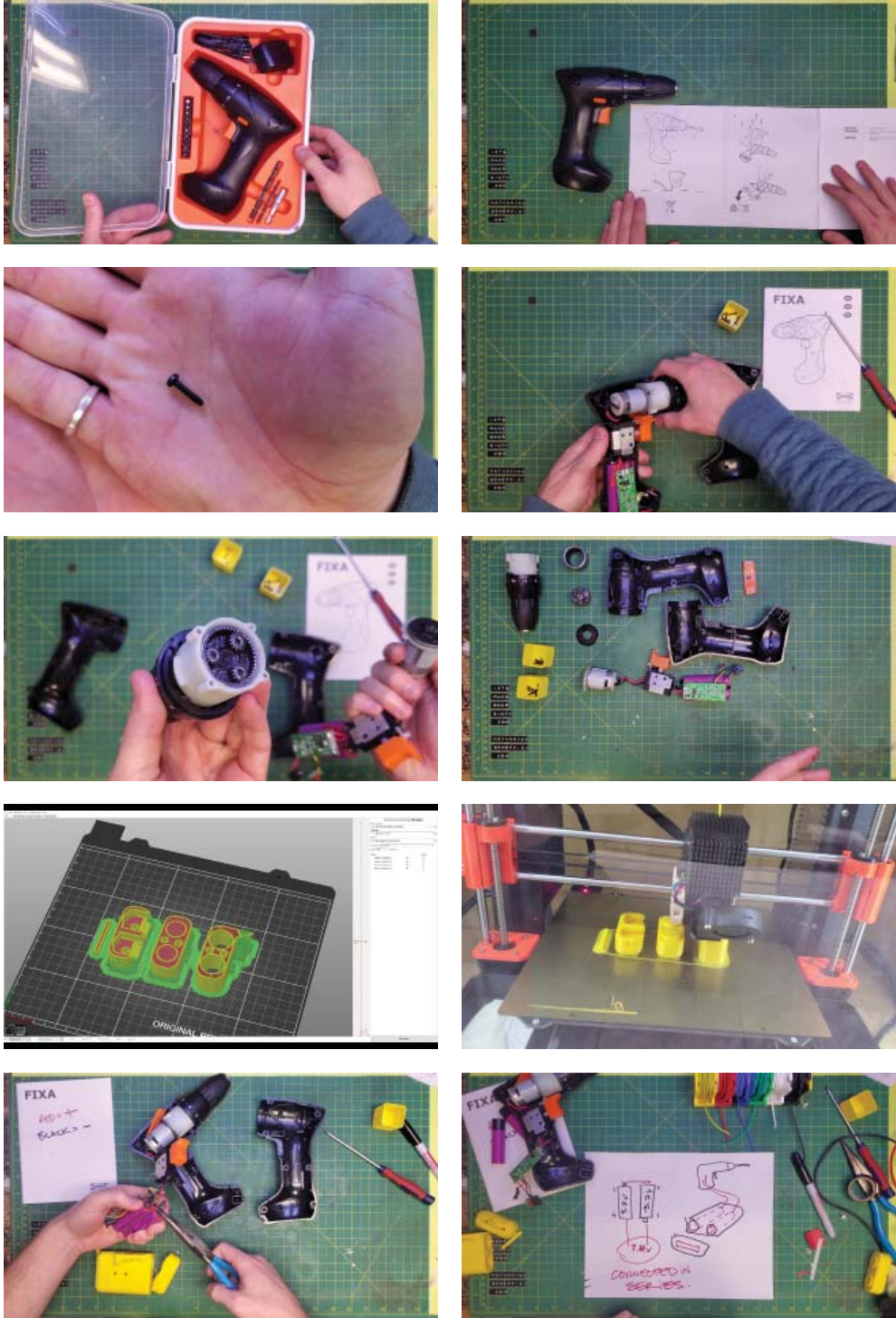
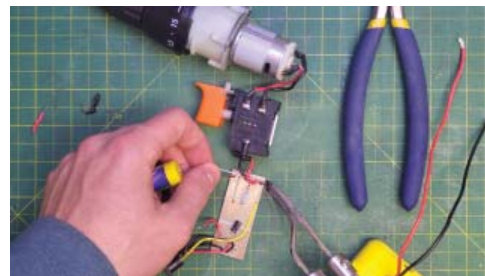


fig. 6.31
IKEA Fixa Video Stills

IKEA FIXA VIDEO STILLS



APPENDIX

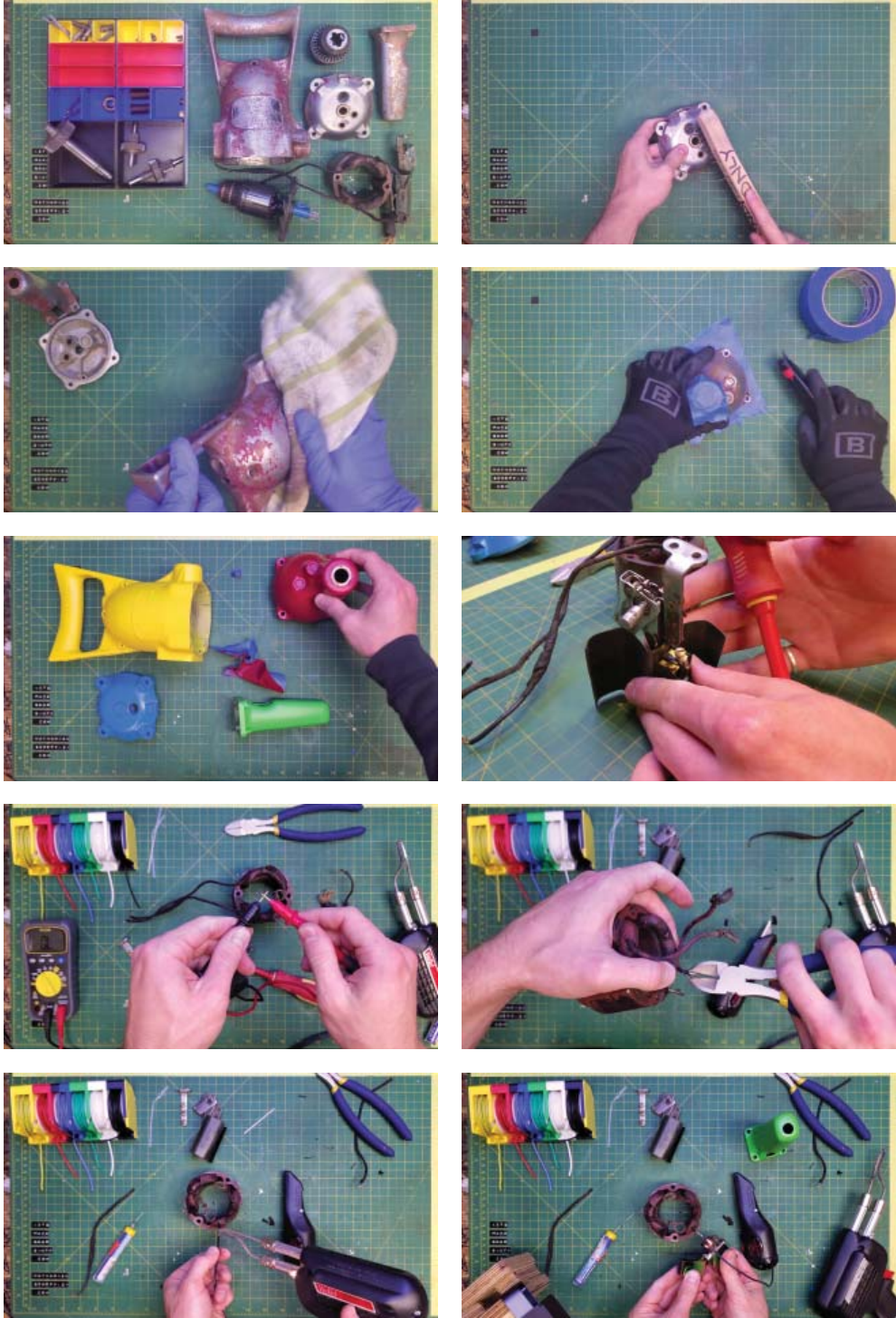
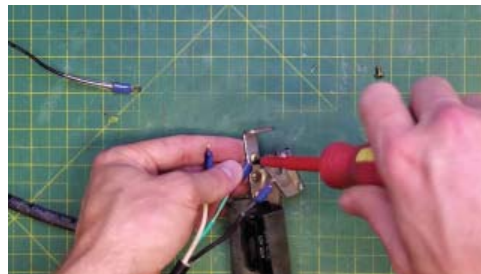


fig. 6.32
Black & Decker Video Stills

BLACK & DECKER VIDEO STILLS



APPENDIX

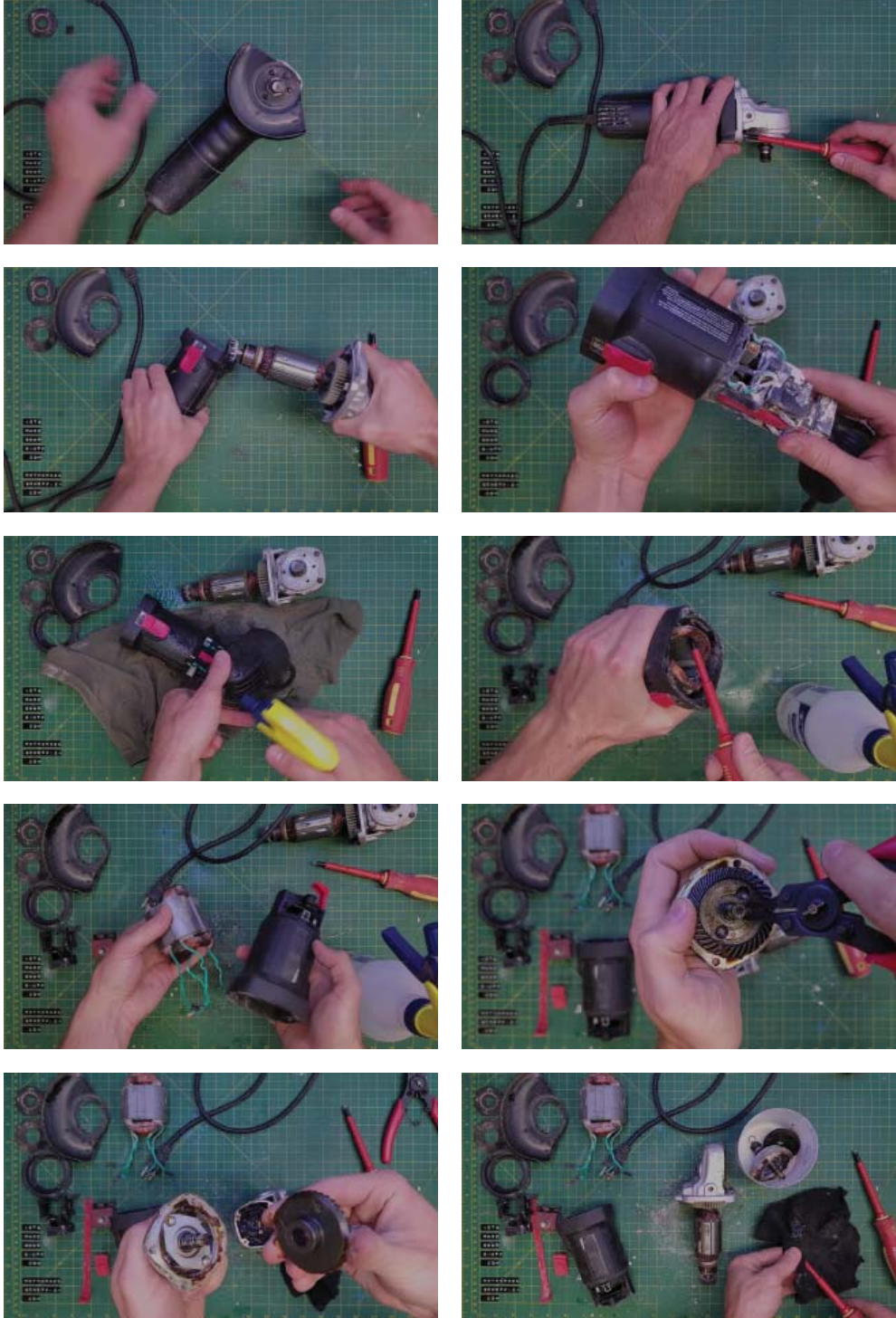


fig. 6.33
Angle Grinder Video Stills

ANGLE GRINDER VIDEO STILLS

